



APPENDIX F

Soil Boring Logs & Monitoring Well Construction Diagrams

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: A-560
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-1	S-2		0.5-1.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-2						Over 3" of wood	
-3							
-4						End of Boring at 1.5'	
-5							
-6							
-7							
-8							
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Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: A-480
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Gray/Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-1	S-2		0.5-1.5'	12"	0	Gray/Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-2						and Brick	
-3						End of Boring at 1.5'	
-4							
-5							
-6							
-7							
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Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 2.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: A-560
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-1							
-2	S-2		0.5-2.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-3							
-4						End of Boring at 2.5'	
-5							
-6							
-7							
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Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: B-60
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5	6"	0	Crushed Stone over Tan, FINE-MEDIUM SAND	
-1	S-2		0.5-1.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Silty Sand and Gravel	
-2						End of Boring at 1.5'	
-3							
-4							
-5							
-6							
-7							
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Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: B-360
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND	
-1							
-2	S-2		0.5-3'	12"	0	Brown, FINE-MEDIUM SAND, Gravel, Brick, Clay and Peat at Tip	
-3						End of Boring at 3'	
-4							
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
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-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: C-160
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel, Cobbles, Brick	
-1							
-2	S-2		0.5-3'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel, Cobbles, Brick	
-3							
-4						End of Boring at 3'	
-5							
-6							
-7							
-8							
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-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: C-280
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown/Tan, FINE-MEDIUM SAND, Some Gravel	
-1							
-2	S-2		0.5-3'	12"	0	Gray FINE SAND, Some Gravel over 5" Wood and Peat	
-3							
-4						End of Boring at 3'	
-5							
-6							
-7							
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-9							
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Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:


TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 2.5'
Date Started: 2/26/2015
Casing ID:
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El.:

BORING ID: C-380
Logged By: Mike Gagne
Contractor: TDS
Sheet #:

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Tan/Brown, FINE-COARSE SAND	
-1							
-2	S-2		0.5-2.5'	12'	0	Tan/Brown, FINE-COARSE SAND, Some Gravel and Brick	
-3							
-4						End of Boring at 2.5'	
-5							
-6							
-7							
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Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID:
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El.:

BORING ID: C-480
Logged By: Mike Gagne
Contractor: TDS
Sheet #:

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Gray/Brown FINE-MEDIUM SAND, Some Gravel and Brick	
-1							
-2	S-2		0.5-3'	17"	0	2" Gray/Brown FINE-MEDIUM SAND, over 15" Tan, FINE-MEDIUM SAND	
-3							
-4							
-5							
-6							
-7							
-8							
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-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: C-560
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Tan/Brown, FINE-MEDIUM SAND, Some Gravel, Cobbles and Brick	
-1							
-2	S-2		0.5-2.5'	12"	0	Same, over 3" Brown, SILTY SAND, Some Peat	
-3							
-4							
-5							
-6							
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-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: D-100
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Crushed Stone	
-1	S-2		0.5-1.5'	12"	0	Crushed Stone over Brown, FINE-MEDIUM SAND,	
-2						Some Peat	
-3						End of Boring at 1.5'	
-4							
-5							
-6							
-7							
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-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: D-260
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Gray, FINE-MEDIUM SAND, Some Gravel and Brick	
-1	S-2		0.5-1'	6"	0	Gray, FINE-MEDIUM SAND, Some Gravel and Brick	
-2							
-3							
-4							
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-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: D-440
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Gray/Tan, FINE-MEDIUM SAND, Some Gravel	
-1	S-2		0.5-1.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel	
-2							
-3							
-4							
-5							
-6							
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-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: E-40
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, SILTY SAND, Some gravel and Cobbles	
-1	S-2		0.5-1.5'	12"	0	Brown, SILTY SAND, Some gravel and Cobbles	
-2							
-3							
-4							
-5							
-6							
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-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: E-120
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel	
-1	S-2		0.5-1.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel	
-2							
-3							
-4							
-5							
-6							
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-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 2.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: E-360
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Cobbles and Brick	
-1							
-2	S-2		0.5-2.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Cobbles and Brick	
-3							
-4						End of Boring at 2.5'	
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
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-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: F-200
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Dark Gray, FINE SAND, Gravel	
-1							
-2	S-2		0.5-3'	12"	0	Dark Gray, FINE SAND, Gravel over Peat/Clay	
-3							
-4						End of Boring at 3'	
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
-14							
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-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: F-280
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Gray, FINE SAND, Gravel and Cobbles	
-1							
-2	S-2		0.5-3'	30"	0	Gray, FINE SAND, Gravel and Cobbles, over 5" of Peat	
-3							
-4						End of Boring at 3'	
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
-14							
-15							
-16							
-17							
-18							
-19							
-20							
-21							
-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID:
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El.:

BORING ID: G-80
Logged By: Mike Gagne
Contractor: TDS
Sheet #:

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-1	S-2		0.5-1.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-2					End of Boring at 1.5'		
-3							
-4							
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
-14							
-15							
-16							
-17							
-18							
-19							
-20							
-21							
-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: G-160
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel	
-1	S-2		0.5-1.5'	12"	0	Brown, FINE-MEDIUM SAND, Some Gravel	
-2							
-3							
-4							
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
-14							
-15							
-16							
-17							
-18							
-19							
-20							
-21							
-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: G-260
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown/Gray Crushed Stone, Some FINE-COARSE SAND	
-1	S-2		0.5-1'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel, Cobbles and Brick	
-2						End of Boring at 1'	
-3							
-4							
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
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-20							
-21							
-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 3'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: H-80
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-1						Little Brick	
-2	S-2		0.5-3'	24"	0	Brown, FINE-MEDIUM SAND, Some Gravel and Cobbles	
-3							
-4						End of Boring at 3'	
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
-14							
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-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1.5'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: H-220
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Brown, FINE-MEDIUM SAND, Over Tan, FINE-MEDIUM SAND	
-1	S-2		0.5-1.5'	12"	0	Tan, FINE-MEDIUM SAND with some Gravel and Brick	
-2							
-3							
-4							
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
-13							
-14							
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-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 1'
Date Started: 2/26/2015
Casing ID: _____
Remarks: Geoprobe

Client: Procon
Location: Chelsea, MA
Completed: 2/26/2015
Ground El. _____

BORING ID: I-100
Logged By: Mike Gagne
Contractor: TDS
Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0	S-1		0-0.5'	6"	0	Wet, Brown, FINE-MEDIUM SAND, over Tan FINE-MEDIUM SAND	
-1	S-2		0.5-1'	12"	0	Tan FINE-MEDIUM SAND, Some Gravel	
-2							
-3							
-4							
-5							
-6							
-7							
-8							
-9							
-10							
-11							
-12							
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-25							
-26							
-27							
-28							
-29							
-30							

Groundwater Measurements				Summary
Date	Time	Depth to Groundwater	Measuring Point	Overburden:
				Rock:
				Well Depth:
				Boring:

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
 Total Depth: 10'
 Date Started: 2/26/2015
 Casing ID: _____
 Remarks: Geoprobe 6010D

Client: Procon, Inc.
 Location: Chelsea, MA
 Completed: 2/26/2015
 Ground El. _____

BORING ID: DW-1R
 Logged By: Mike Gagne
 Contractor: TDS
 Sheet #: _____

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0						No Samples Taken	
-1							
-2						Bentonite Seal-	
-3							
-4							
-5							
-6						8 Feet of Screen-	
-7							
-8							
-9							
-10						2" Monitoring Well Installed at 10'	
-11							
-12							
-13							
-14							
-15							
-16							
-17							
-18							
-19							
-20							
-21							
-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							
Groundwater Measurements						Summary	
Date	Time	Depth to Groundwater	Measuring Point	Overburden:	NA		
				Rock:	NA		
				Well Depth:	NA		
				Boring:	10'		

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
Total Depth: 10'
Date Started: 10/27/2014
Casing ID:
Remarks: Geoprobe 6010D

Client: Procon, Inc.
Location: Chelsea, MA
Completed: 10/27/2014
Ground El.:

BORING ID: DW-1
Logged By: Mike Gagne
Contractor: TDS
Sheet #:

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0						No Samples Taken 	

TEST BORING LOG

CDW Consultants, Inc.

Project No.: 1435.00
 Total Depth: 10'
 Date Started: 10/28/2014
 Casing ID:
 Remarks: Geoprobe 6010D

Client: Procon, Inc.
 Location: Chelsea, MA
 Completed: 10/28/2014
 Ground El.:

BORING ID: DW-2
 Logged By: Mike Gagne
 Contractor: TDS
 Sheet #:

Depth (Feet)	Sample				PID Hdspace (ppm)	Sample Description	Well Diagram
	Type & Num.	Blows per 6 Inches	Depth Range	Recovery			
0						No Samples Taken	
-1							
-2							
-3	S-1		0-5'	24"	0	Wet, Brown, FINE-MEDIUM SAND, Some Gravel, Some Cobbles Over	
-4						Black, FINE-MEDIUM SAND, Some Peat	
-5							
-6						8 Feet of Screen-	
-7							
-8	S-2		5-10'	24"	0	Wet, Peat	
-9							
-10						1" Monitoring Well Installed at 10'	
-11							
-12							
-13							
-14							
-15							
-16							
-17							
-18							
-19							
-20							
-21							
-22							
-23							
-24							
-25							
-26							
-27							
-28							
-29							
-30							
Groundwater Measurements						Summary	
Date	Time	Depth to Groundwater	Measuring Point	Overburden:	NA		
				Rock:	NA		
				Well Depth:	NA		
				Boring:	10'		



*Risk -Based Cleanup & Disposal Plan
145-155 Beech Street, Chelsea MA
MassDEP RTN 3-17917*

APPENDIX G

Weston & Sampson Groundwater Sampling Documentation

Appendix C.8
Supplemental Phase II Groundwater Sampling Results
144-145 Beech Street
Chelsea, MA

Parameter	MCP Method 1 Cleanup Standards		UNITS	SAMPLING LOCATION															
	GW-2	GW-3		A-MW	B-MW	MWS-1	MWS-2	NC-320	NC-321	DUP-1	OWG	MWS-3	NC 341	OWA	OWB	OWC	OWD	OWE	PMW-8
				2/17/2012	2/17/2012	2/17/2012	2/17/2012	2/17/2012	2/17/2012	2/17/2002	2/17/2012	2/16/2012	2/16/2012	2/16/2012	2/16/2012	2/16/2012	2/16/2012	2/16/2012	2/16/2012
PCBs																			
PCB 1016	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1221	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1232	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1242	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1248	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1254	5	10	µg/L	<0.20	<0.20	0.57	0.61	<0.20	<0.20	0.38	2.5	0.35	<1.0	0.32	0.28	0.27	<1.0	<0.20	0.4
PCB 1260	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1262	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
PCB 1268	5	10	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20	<0.20	<1.0	<0.20	<0.20
Total PCBs	5	10	µg/L	<0.20	<0.20	0.57	0.61	<0.20	<0.20	0.38	2.5	0.35	1.6	0.32	0.61	0.27	1.2	0.29	0.9

O:\Chelsea MA\Brownfields Program\Closure Report\Appendix\Appendix - Supplemental Data\[Supp Phase II Data Tables.xlsx]GW Results

NOTES:
PCB = Polychlorinated Biphenyls
µg/L = Micrograms per liter
"<" = Not detected above the laboratory method detection limit shown.
BOLD = Detected above the laboratory method dection limit.
BOLD = Detected above MCP Method 1 Cleanup Standards

TABLE 3
Historic Groundwater PCB Sampling Results
145-155 Beech Street
Chelsea, Massachusetts

Sampling Location	Date Collected	Total PCB Concentrations
NC-303	3/15/2000	0.71
NC-306	3/15/2000	7.1
	6/15/2000	5.76
NC-340 ¹	11/20/2001	<2.5
	12/7/2001	<2.5
	1/11/2002	2.17
	1/15/2003	2.59
	3/27/2003	0.859
NC-307	3/15/2000	<0.3
NC-310	3/15/2000	<0.3
NC-319	3/15/2000	<0.3
NC-321	5/28/1999	<2.5
NC-322	5/28/1999	7.8
	3/15/2000	2.2
NC-336 ²	11/29/2001	<0.254
	12/7/2001	2.73
	1/11/2002	1.14
	1/15/2003	0.498
	3/27/2003	ND
NC-337	11/20/2001	41.5
	12/7/2001	68.2
	12/7/2001	128
	1/15/2003	418
	3/27/2003	77.4
NC-341	11/29/2001	7.34
	12/7/2001	7.36
	1/11/2002	5.18
	1/15/2003	26.1
	3/27/2003	4.01
	7/2/2007	1.34
CDW-1 070207/OW-A	7/2/2007	<0.286
CDW-2 070207	7/2/2007	<0.253
CDW-3 070207	7/2/2007	0.524
CDW-5 070207/PMW-8	7/2/2007	3.07
CDW-6 070207/OW-D	7/2/2007	0.877

Notes:

"<" - denotes sampling results were below the laboratory detection limit (LDL).

ND - denotes sample result was not detected above LDL. No LDL provided.

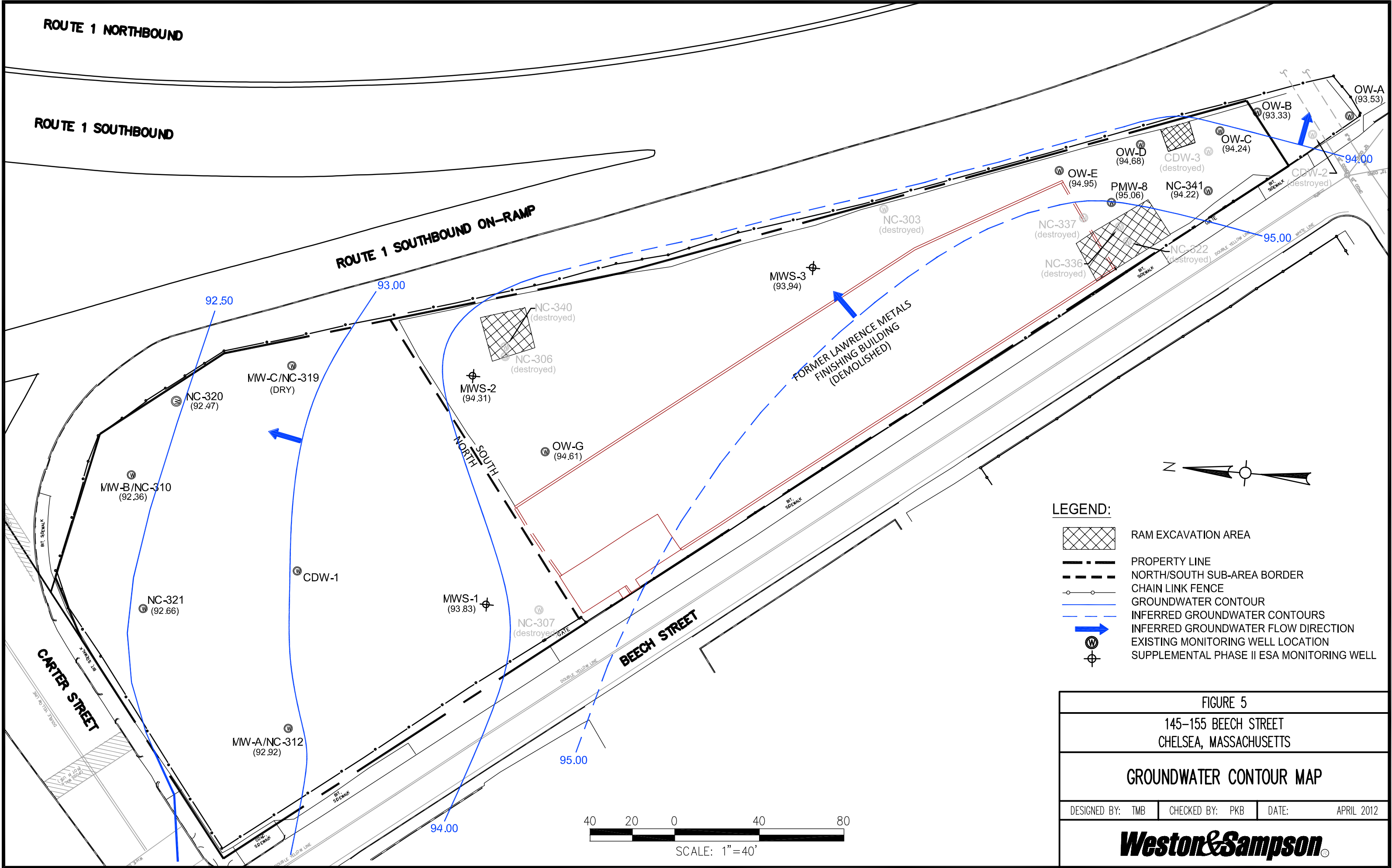
 = Sample results exceeds MCP Method 1 GW-2 Groundwater Standard (5 ug/L)

1. Monitoring well NC-341 installed to replace NC-306.

2. Monitoring well NC-336 installed to replace NC-322.

3. CDW sampling locations inferred from plan provided in July 2007 summary report.

O:\Chelsea MA\Brownfields Program\CAD\Phase II Figures\GW Contour Map.dwg





*Risk -Based Cleanup & Disposal Plan
145-155 Beech Street, Chelsea MA
MassDEP RTN 3-17917*

APPENDIX H

EPC Calculations Documentation

Adjustment Factor = 2.1

Sample ID	Sample Depth Below Fabric (ft)	Testing Method	Sampler	Measured Total PCB Concentrations (mg/kg)	Adjusted Total PCB Concentrations (mg/kg)	Status
A020	5	Field Screen	EPA	6	12.6	
A040	5	Field Screen	EPA	10	21	
A060	5	Field Screen	EPA	3.1	6.51	
A080	5	Field Screen	EPA	16	33.6	
A100	5	Field Screen	EPA	2.6	5.46	
A120	5	Field Screen	EPA	0.7	1.47	
A140	5	Field Screen	EPA	1.7	3.57	
A160	8	Field Screen	EPA	1.2	2.52	
A180	8	Field Screen	EPA	<0.21	0.441	
A200	8	Field Screen	EPA	<0.21	0.441	
A220	2	Field Screen	EPA	5.7	11.97	to be removed
A240	2	Field Screen	EPA	8.3	17.43	to be removed
A260	2	Field Screen	EPA	6.3	13.23	to be removed
A280	2	Field Screen	EPA	11	23.1	to be removed
A300	8	Field Screen	EPA	<0.21	0.441	
A320	3	Field Screen	EPA	34	71.4	to be removed
A340	4	Field Screen	EPA	30	63	
A360	4	Field Screen	EPA	42	88.2	
A380	4	Field Screen	EPA	48	100.8	
A400	4	Field Screen	EPA	62	130.2	
A420	5	Field Screen	EPA	<0.21	0.441	
A440	5	Field Screen	EPA	2.9	6.09	
A460	4	Field Screen	EPA	13	27.3	
A480	5	Field Screen	EPA	17	35.7	
A500	7	Field Screen	EPA	17	35.7	
A520	7	Field Screen	EPA	0.26	0.546	
A540	7	Field Screen	EPA	<0.21	0.441	
A560	7	Field Screen	EPA	0.93	1.953	
A580	7	Field Screen	EPA	0.95	1.995	
A600	7	Field Screen	EPA	1.1	2.31	
A-620		Lab Data	EPA	13	13	
B020	5	Field Screen	EPA	11.2	23.52	
B040	5	Field Screen	EPA	<0.21	0.441	
B060	5	Field Screen	EPA	5.7	11.97	
B080	5	Field Screen	EPA	5.2	10.92	
B100	5	Field Screen	EPA	36	75.6	
B-120		Lab Data	EPA	11.3	11.3	
B140	5	Field Screen	EPA	<0.21	0.441	
B160	8	Field Screen	EPA	<0.21	0.441	
B180	8	Field Screen	EPA	<0.21	0.441	
B200	8	Field Screen	EPA	<0.21	0.441	
B220	2	Field Screen	EPA	0.87	1.827	to be removed
B240	2	Field Screen	EPA	11	23.1	to be removed
B260	2	Field Screen	EPA	20	42	to be removed
B280	2	Field Screen	EPA	22	46.2	to be removed
B300	10	Field Screen	EPA	<0.21	0.441	
B320	8	Field Screen	EPA	<0.21	0.441	
B340	8	Field Screen	EPA	<0.21	0.441	
B360	8	Field Screen	EPA	<0.21	0.441	
B380	10	Field Screen	EPA	<0.21	0.441	
B400	8	Field Screen	EPA	<0.21	0.441	
B420	8	Field Screen	EPA	<0.21	0.441	
B440	8	Field Screen	EPA	<0.21	0.441	
B460	8	Field Screen	EPA	<0.21	0.441	
B-480		Lab Data	EPA	230	230	
B500	7	Field Screen	EPA	1.8	3.78	
B520	7	Field Screen	EPA	26	54.6	
B540	7	Field Screen	EPA	0.27	0.567	
B560	7	Field Screen	EPA	2.8	5.88	
B580	7	Field Screen	EPA	1.6	3.36	
B600	7	Field Screen	EPA	1.1	2.31	
B620	3	Field Screen	EPA	11	23.1	
C020	5	Field Screen	EPA	2.3	4.83	
C040	5	Field Screen	EPA	<0.21	0.441	
C060	5	Field Screen	EPA	17	35.7	
C080	5	Field Screen	EPA	4.8	10.08	
C-100		Lab Data	EPA	4.6	9.66	
C120	5	Field Screen	EPA	<0.21	0.441	
C140	5	Field Screen	EPA	5.2	10.92	
C160	8	Field Screen	EPA	12	25.2	
C180	8	Field Screen	EPA	<0.21	0.441	
C200	8	Field Screen	EPA	<0.21	0.441	
C220	4	Field Screen	EPA	51	107.1	
C240	4	Field Screen	EPA	49	102.9	
C260	4	Field Screen	EPA	8.1	17.01	to be removed
C280	8	Field Screen	EPA	<0.21	0.441	
C300	4	Field Screen	EPA	14	29.4	to be removed
C320	7	Field Screen	EPA	2.2	4.62	
C340	7	Field Screen	EPA	6.4	13.44	
C360	7	Field Screen	EPA	1.8	3.78	
C380	7	Field Screen	EPA	40	84	
C400	7	Field Screen	EPA	<0.21	0.441	
C420	4	Field Screen	EPA	14	29.4	
C440	4	Field Screen	EPA	10	21	
C460	4	Field Screen	EPA	43	90.3	
C480	8	Field Screen	EPA	<0.21	0.441	
C500	8	Field Screen	EPA	<0.21	0.441	
C520	7	Field Screen	EPA	16	33.6	
C540	7	Field Screen	EPA	10	21	
C560	7	Field Screen	EPA	16	33.6	
D020	5	Field Screen	EPA	0.29	0.609	

D-040		Lab Data	EPA	9.9	9.9	
D060	5	Field Screen	EPA	<0.21	0.441	
D080	5	Field Screen	EPA	4	8.4	
D100	5	Field Screen	EPA	1.7	3.57	
D120	5	Field Screen	EPA	10.4	21.84	
D140	5	Field Screen	EPA	15.2	31.92	
D160	8	Field Screen	EPA	18	37.8	
D180	8	Field Screen	EPA	<0.21	0.441	
D200	8	Field Screen	EPA	<0.21	0.441	
D220	4	Field Screen	EPA	79	165.9	
D240	4	Field Screen	EPA	81	170.1	
D260	4	Field Screen	EPA	58	121.8	
D280	8	Field Screen	EPA	<0.21	0.441	
D300	4	Field Screen	EPA	8.1	17.01	to be removed
D320	7	Field Screen	EPA	1.5	3.15	
D340	7	Field Screen	EPA	3	6.3	
D360	7	Field Screen	EPA	0.7	1.47	
D380	7	Field Screen	EPA	4.3	9.03	
D400	7	Field Screen	EPA	8.2	17.22	
D440	5	Field Screen	EPA	4.6	9.66	
D480	5	Field Screen	EPA	28	58.8	
D500	7	Field Screen	EPA	15	31.5	
E020	5	Field Screen	EPA	<0.21	0.441	
E040	5	Field Screen	EPA	0.92	1.932	
E060	5	Field Screen	EPA	1.3	2.73	
E080	5	Field Screen	EPA	<0.21	0.441	
E100	5	Field Screen	EPA	<0.21	0.441	
E120	5	Field Screen	EPA	<0.21	0.441	
E140	3	Field Screen	EPA	25.1	52.71	
E160	8	Field Screen	EPA	11	23.1	
E180	8	Field Screen	EPA	2.8	5.88	
E200	4	Field Screen	EPA	6.3	13.23	
E220	10	Field Screen	EPA	<0.21	0.441	
E240	8	Field Screen	EPA	2.1	4.41	
E260	10	Field Screen	EPA	<0.21	0.441	
E280	4	Field Screen	EPA	0.49	1.029	
E300	4	Field Screen	EPA	50	105	to be removed
E320	7	Field Screen	EPA	24	50.4	
E340	7	Field Screen	EPA	9.9	20.79	
E360	7	Field Screen	EPA	3.3	6.93	
E380	7	Field Screen	EPA	0.9	1.89	
E-400/420		Lab Data	EPA	7.6	7.6	
F020	5	Field Screen	EPA	2.7	5.67	
F040	5	Field Screen	EPA	<0.21	0.441	
F060	5	Field Screen	EPA	<0.21	0.441	
F080	5	Field Screen	EPA	<0.21	0.441	
F100	5	Field Screen	EPA	<0.21	0.441	
F120	5	Field Screen	EPA	<0.21	0.441	
F140	3	Lab Data	EPA	63	63	to be removed
F160	3	Field Screen	EPA	21.3	44.73	to be removed
F180	8	Field Screen	EPA	<0.21	0.441	
F200	8	Field Screen	EPA	0.38	0.798	
F220	8	Field Screen	EPA	3.2	6.72	
F240	8	Field Screen	EPA	4.9	10.29	
F260	5	Field Screen	EPA	<0.21	0.441	
F280	8	Field Screen	EPA	0.34	0.714	
F300	10	Field Screen	EPA	<0.21	0.441	
F320	7	Field Screen	EPA	6.6	13.86	
F340	7	Field Screen	EPA	1.3	2.73	
F360	7	Field Screen	EPA	0.8	1.68	
F380	7	Field Screen	EPA	7.2	15.12	
G020	5	Field Screen	EPA	<0.21	0.441	
G040	5	Field Screen	EPA	15.1	31.71	
G060	5	Field Screen	EPA	3.6	7.56	
G080	5	Field Screen	EPA	19.5	40.95	
G100	5	Field Screen	EPA	6.8	14.28	
G120	5	Field Screen	EPA	24.1	50.61	
G140	5	Field Screen	EPA	<0.21	0.441	
G160	5	Field Screen	EPA	1.5	3.15	
G180	6	Field Screen	EPA	<0.21	0.441	
G200	8	Field Screen	EPA	<0.21	0.441	
G220	10	Field Screen	EPA	<0.21	0.441	
G240	5	Field Screen	EPA	0.8	1.68	
G260	4	Field Screen	EPA	74	155.4	
G280	4	Field Screen	EPA	50	105	
G300	4	Field Screen	EPA	8.7	18.27	
G320	7	Field Screen	EPA	12	25.2	
H-020		Lab Data	EPA	0.41	0.41	
H040	8	Field Screen	EPA	0.21	0.441	
H060	8	Field Screen	EPA	2.3	4.83	
H080	8	Field Screen	EPA	0.4	0.84	
H100	8	Field Screen	EPA	2.3	4.83	
H120	8	Field Screen	EPA	<0.21	0.441	
H140	8	Field Screen	EPA	<0.21	0.441	
H160	8	Field Screen	EPA	<0.21	0.441	
H180	8	Field Screen	EPA	<0.21	0.441	
H200	8	Field Screen	EPA	<0.21	0.441	
H220	5	Field Screen	EPA	<0.21	0.441	
H260	4	Field Screen	EPA	90	189	
I040	5	Field Screen	EPA	10	21	
I060	5	Field Screen	EPA	3.3	6.93	
I080	3	Field Screen	EPA	16	33.6	
I100	4	Field Screen	EPA	21.9	45.99	
I120	3	Field Screen	EPA	13.5	28.35	to be removed
I140	3	Lab Data	EPA	80	80	to be removed
I160	8	Field Screen	EPA	<0.21	0.441	

I180	8	Field Screen	EPA	<0.21	0.441	
I200	5	Field Screen	EPA	<0.21	0.441	
J060	5	Field Screen	EPA	22	46.2	
J-080		Lab Data	EPA	37	37	
J100	3	Field Screen	EPA	21	44.1	
J120	3	Field Screen	EPA	12.6	26.46	to be removed
J140	3	Field Screen	EPA	28.4	59.64	
J160	10	Field Screen	EPA	1.1	2.31	
A40	0.5	Lab Data	CDW	0.99	0.99	to be removed
A60	0.5	Lab Data	CDW	1.2	1.2	to be removed
A80	0.5	Lab Data	CDW	0.39	0.39	to be removed
A100	0.5	Lab Data	CDW	<0.5	0.5	to be removed
A140	0.5	Lab Data	CDW	23.2	23.2	to be removed
A220	2'-3'	Lab Data	CDW	<0.5	0.5	to be removed
A220	4'-5'	Lab Data	CDW	<0.5	0.5	to be removed
A240	2'-3'	Lab Data	CDW	12.7	12.7	to be removed
A240	4'-5'	Lab Data	CDW	<1.71	1.71	to be removed
A260	2'-3'	Lab Data	CDW	0.27	0.27	to be removed
A260	4'-5'	Lab Data	CDW	<0.63	0.63	to be removed
A280	2'-3'	Lab Data	CDW	<1.08	1.08	to be removed
A280	4'-5'	Lab Data	CDW	<0.59	0.59	to be removed
A300	0'-1'	Lab Data	CDW	<0.59	0.59	to be removed
A320	2'-3'	Lab Data	CDW	<0.77	0.77	to be removed
A340	1'-2'	Lab Data	CDW	68	68	to be removed
A360	1'-2'	Lab Data	CDW	53	53	to be removed
A380	1'-2'	Lab Data	CDW	29	29	to be removed
A400	1'-2'	Lab Data	CDW	<0.95	0.95	to be removed
A420	1'-2'	Lab Data	CDW	11.6	11.6	
A440	1'-2'	Lab Data	CDW	<0.77	0.77	to be removed
A460	1'-2'	Lab Data	CDW	62	62	to be removed
B40	0.5'	Lab Data	CDW	0.75	0.75	to be removed
B220	2'-3'	Lab Data	CDW	0.21	0.21	to be removed
B240	2'-3'	Lab Data	CDW	22.2	22.2	to be removed
B260	3'-4'	Lab Data	CDW	22	22	to be removed
B260	6'-7'	Lab Data	CDW	<0.54	0.54	to be removed
B280	4'-5'	Lab Data	CDW	<1.7	1.7	to be removed
B300	3'-4'	Lab Data	CDW	<0.59	0.59	to be removed
B320	0.5'	Lab Data	CDW	0.12	0.12	to be removed
B340	0.5'	Lab Data	CDW	0.27	0.27	to be removed
C60	1'-3'	Lab Data	CDW	0.29	0.29	to be removed
C220	2'-3'	Lab Data	CDW	<0.5	0.5	to be removed
C240	2'-3'	Lab Data	CDW	49	49	to be removed
C260	1'-2'	Lab Data	CDW	11.3	11.3	to be removed
C260	3'-4'	Lab Data	CDW	<1.76	1.76	to be removed
C300	3'-4'	Lab Data	CDW	62	62	to be removed
C400	3'-4'	Lab Data	CDW	0.62	0.62	to be removed
C520	3'-4'	Lab Data	CDW	<0.59	0.59	to be removed
D60	1'-2'	Lab Data	CDW	8.6	8.6	to be removed
D160	3'-4'	Lab Data	CDW	0.64	0.64	to be removed
D180	3'-4'	Lab Data	CDW	<0.54	0.54	to be removed
D220	2'-3'	Lab Data	CDW	<0.45	0.45	to be removed
D240	2'-3'	Lab Data	CDW	1.44	1.44	to be removed
D260	2'-3'	Lab Data	CDW	4.2	4.2	
D300	3'-4'	Lab Data	CDW	<1.5	1.5	to be removed
E180	3'-4'	Lab Data	CDW	<0.63	0.63	to be removed
E200	3'-4'	Lab Data	CDW	<1.8	1.8	to be removed
E280	3'-4'	Lab Data	CDW	<0.54	0.54	to be removed
E300	3'-4'	Lab Data	CDW	<0.54	0.54	to be removed
E440	0.5'	Lab Data	CDW	44	44	to be removed
F140	3'-4'	Lab Data	CDW	<0.95	0.95	to be removed
F160	3'-5'	Lab Data	CDW	<0.77	0.77	to be removed
F160	7'-9'	Lab Data	CDW	<0.59	0.59	to be removed
F180	3'-4'	Lab Data	CDW	22.2	22.2	to be removed
F260	2'-3'	Lab Data	CDW	1.28	1.28	to be removed
G20	0.5'	Lab Data	CDW	0.64	0.64	to be removed
G40	0.5'	Lab Data	CDW	0.68	0.68	to be removed
G120	0.5'	Lab Data	CDW	28	28	to be removed
G140	0.5'	Lab Data	CDW	13.4	13.4	to be removed
G240	2'-3'	Lab Data	CDW	68	68	to be removed
H280	1'-2'	Lab Data	CDW	3.58	3.58	to be removed
I120	5'-6'	Lab Data	CDW	<1.44	1.44	to be removed
I140	3'-6'	Lab Data	CDW	4.75	4.75	to be removed
I200	1'-2'	Lab Data	CDW	76	76	to be removed
J100	0.5'	Lab Data	CDW	2.5	2.5	to be removed
J140	1'-2'	Lab Data	CDW	0.64	0.64	to be removed
current EPC EPA samples				11.7	22.0	
current EPC all samples				11.5	19.2	
Estimated future EPC samples				10.6	20.4	

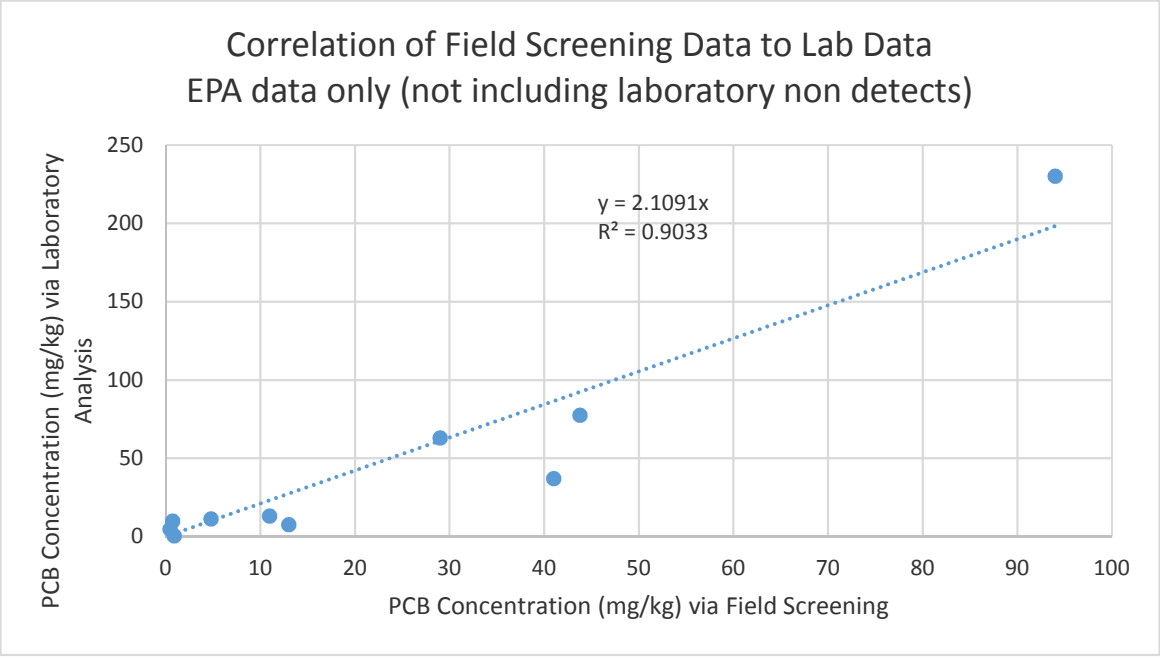
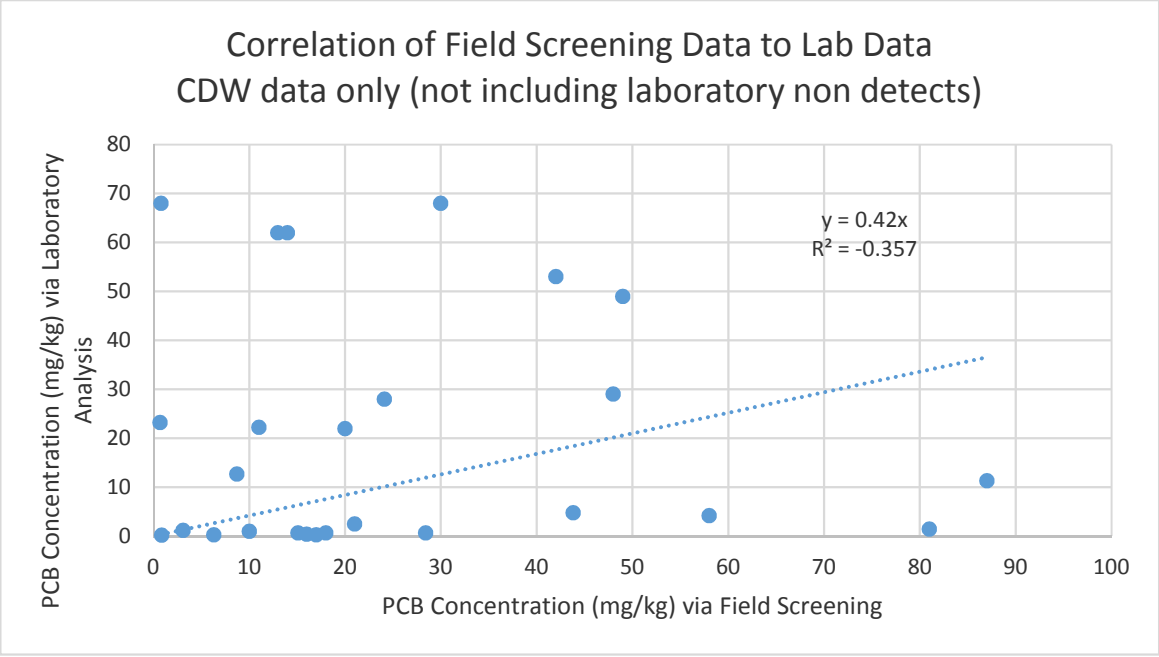
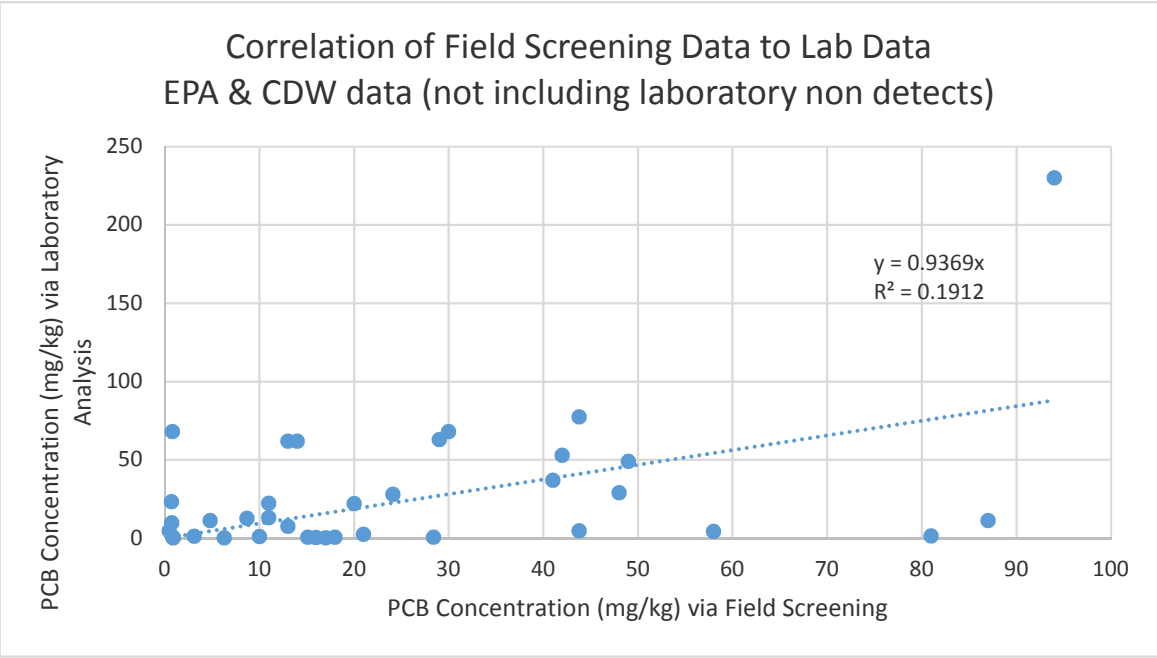
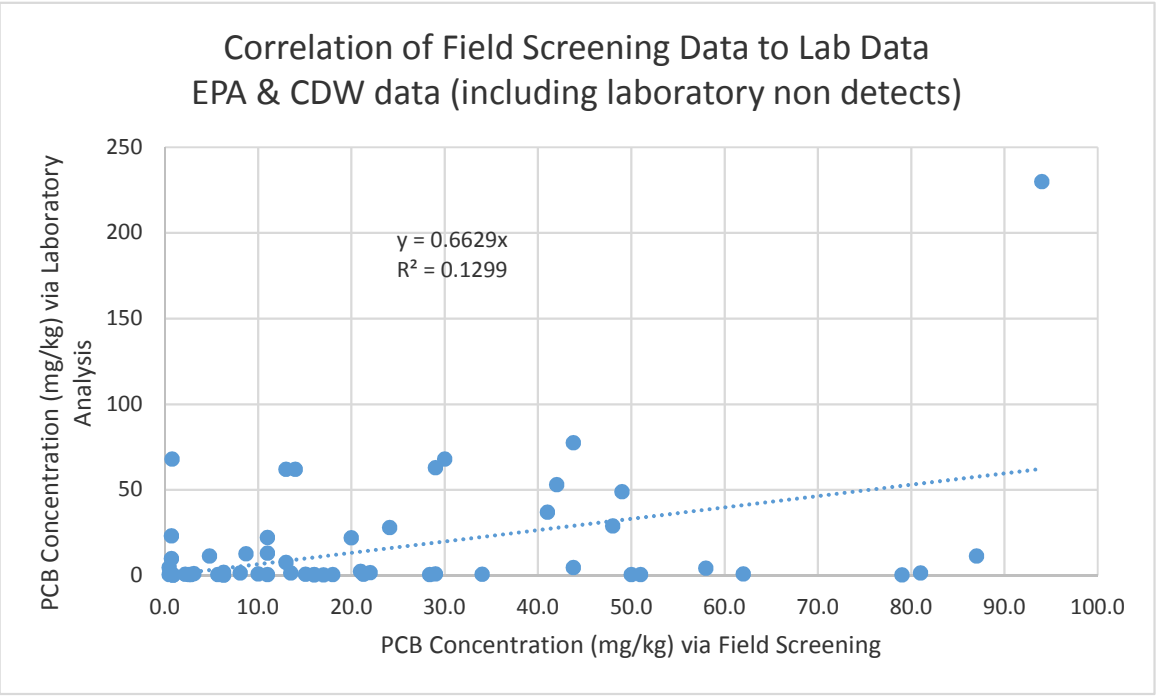
No. of Total samples = 262
No. of Total Lab Data samples = 77
No. of CDW Lab Data samples = 67
No. of EPA Lab Data samples = 10
No. of Field Screen samples = 185
No. of samples to be removed = 83
total no. of samples used in future EPC = 179

Notes:
Field Screening values shown as <0.21 were non-detect; 0.21 mg/kg was selected to calculated the EPC because it was the lowest concentration detected during field screening.
A < symbol before a value indicates that the sample was ND; the value represents 1/2 of the sum of the individual detection limits for each arochlor.

A620	3	Field Screen		11	23.1	Superceded by Lab data
B120	5	Field Screen		4.8	10.08	Superceded by Lab data
B480	5	Field Screen		94	197.4	Superceded by Lab data
C100	5	Field Screen		0.48	1.008	Superceded by Lab data
D040	5	Field Screen		0.73	1.533	Superceded by Lab data
E400	7	Field Screen		13	27.3	Superceded by Lab data
F140	3	Field Screen	EPA	29	60.9	Superceded by Lab data
H020	3	Field Screen		0.9	1.89	Superceded by Lab data
I140	3	Field Screen	EPA	43.8	91.98	Superceded by Lab data
J080	3	Field Screen		41	86.1	Superceded by Lab data

Selection of Field Screening Ajustment Factor

Grid		Depth of Fabric Below Grade	Excavation			2014 Sampling					EPA PCB Field Screening Results (mg/kg)
			Area (sf)	Depth (ft) below Fabric	Volume (cy)	Sample Depth Below Grade	Sample Depth Below Fabric	Total PCBs Lab results (mg/kg)	Sample Collection Date	Sample Analysis Date	
A	100	3'	156.7	0.5	2.90	3.5'	0.5'	<0.5	10/28/14	11/4/14	2.6
A	220	at grade	149.7	2.1	11.64	2-3'	2-3'	<0.5	10/27/14	11/4/14	5.7
A	280	at grade	48.0	5.0	8.89	4-5'	4-5'	<0.59	11/7/14	11/15/14	11
A	320	1'	12.5	3.0	1.39	3-4'	2-3'	<0.77	10/27/14	11/4/14	34
A	400	1'	129.7	1.1	5.28	2-3'	1-2'	<0.95	10/27/14	11/4/14	62
A	440	1'	12.6	1.0	0.47	2-3'	1-2'	<0.77	10/27/14	11/4/14	2.2
B	280	at grade	76.6	6.5	18.44	4-5'	4-5'	<1.7	10/27/14	11/3/14	22
C	220	2'	400.0	3.0	44.44	4-5'	2-3'	<0.5	10/27/14	11/4/14	51
C	520	8'	52.9	3.5	6.86	11-12'	3-4'	<0.59	10/28/14	11/4/14	16
D	220	2'	400.0	3.0	44.44	4-5'	2-3'	<0.45	10/27/14	11/4/14	79
D	300	1'	57.6	4.2	8.96	4-5'	3-4'	<1.5	10/28/14	11/3/14	8.1
E	180	8'	81.6	4.5	13.60	11-12'	3-4'	<0.63	10/28/14	11/1/14	2.8
E	200	2'	125.8	3.4	15.84	5-6'	3-4'	<1.8	10/28/14	10/31/14	6.3
E	280	10'	111.5	3.9	16.11	13-14'	3-4'	<0.54	10/28/14	11/4/14	0.49
E	300	10'	50.4	7.1	13.25	13-14'	3-4'	<0.54	10/28/14	11/3/14	50
F	140	3'	167.1	4.0	24.76	6-7'	3-4'	<0.95	10/28/14	10/31/14	29
F	160	1'	55.5	4.5	9.33	4-5'	3-5'	<0.77	10/28/14	11/1/14	21.3
I	120	1'	23.0	6.3	5.37	6-7'	5-6'	<1.44	10/28/14	11/1/14	13.5
A	40	3'	218.3	1.0	8.08	3.5'	0.5'	0.99	10/28/14	11/1/14	10
A	60	3'	180.0	1.0	6.67	3.5'	0.5'	1.20	10/28/14	11/4/14	3.1
A	80	3'	156.7	0.5	2.90	3.5'	0.5'	0.39	10/28/14	11/4/14	16
A	140	3'	148.7	0.5	2.75	3.5'	0.5'	23.2	10/28/14	11/4/14	0.7
A	240	at grade	149.4	2.1	11.62	2-3'	2-3'	12.7	10/27/14	11/4/14	8.7
A	260	at grade	149.3	2.1	11.61	2-3'	2-3'	0.27	10/27/14	11/4/14	6.3
A	340	1'	151.3	1.1	6.16	2-3'	1-2'	68	10/27/14	11/4/14	30
A	360	1'	129.7	1.1	5.28	2-3'	1-2'	53	10/27/14	11/5/14	42
A	380	1'	129.7	1.1	5.28	2-3'	1-2'	29	10/27/14	11/4/14	48
A	460	1'	129.7	1.1	5.28	2-3'	1-2'	62	11/7/14	11/15/14	13
B	220	at grade	400.0	5.0	74.07	2-3'	2-3'	0.21	10/27/14	11/4/14	0.87
B	240	at grade	400.0	5.0	74.07	2-3'	2-3'	22.2	10/27/14	11/4/14	11
B	260	at grade	52.9	5.0	9.80	3-4'	3-4'	22	10/27/14	11/4/14	20
C	60	3'	114.3	2.5	10.58	4-6'	1-3'	0.29	10/28/14	11/4/14	17.00
C	240	2'	400.0	3.0	44.44	4-5'	2-3'	49	10/27/14	11/4/14	49
C	260	2'	382.6	3.0	42.51	3-4'	1-2'	11.3	10/27/14	11/4/14	87
C	300	1'	62.3	4.2	9.69	4-5'	3-4'	62	10/28/14	11/1/14	14
D	160	8'	18.4	4.0	2.73	11-12'	3-4'	0.64	10/28/14	11/3/14	18
D	240	2'	400.0	3.0	44.44	4-5'	2-3'	1.44	10/27/14	11/4/14	81
D	260	2'	0.0	0.0	0.00	4-5'	2-3'	4.2	10/27/14	11/4/14	58
G	40	1'	309.7	0.5	5.74	1.5'	0.5	0.68	11/7/14	11/15/14	15.1
G	120	1'	174.4	0.5	3.23	1.5'	0.5'	28	10/28/14	11/1/14	24.1
G	240	1'	31.3	2.4	2.78	3-4'	2-3'	68	10/28/14	11/4/14	0.8
I	140	1'	21.8	6.3	5.09	4-7'	3-6'	4.75	10/28/14	11/1/14	43.8
J	100	1'	12.6	1.0	0.47	1.5'	0.5'	2.5	10/28/14	11/1/14	21
J	140	1'	283.3	1.5	15.42	2-3'	1-2'	0.64	10/28/14	11/1/14	28.4
A	620						3'	13			11
B	120						5'	11.3			4.8
B	480						5'	230			94.0
C	100						5'	4.6			0.48
D	40						5'	9.9			0.73
E	400						7'	7.6			13
F	140						3'	63			29
H	20						3'	0.41			0.9
I	140						3'	77.5			43.8
J	80						3'	37			41





*Risk -Based Cleanup & Disposal Plan
145-155 Beech Street, Chelsea MA
MassDEP RTN 3-17917*

APPENDIX I

Method 3 Shortforms

Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk

Based on Construction Worker 18-25 years of age

ShortForm Version 10-12

Vlookup Version v0414

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

ELCR (all chemicals) = 4.0E-07

HI (all chemicals) = 5.8E-01

Oil or Hazardous	EPC	ELCR	ELCR	ELCR	ELCR		Subchronic				
Material (OHM)	(mg/kg)	ingestion	dermal	inhalation GI	inhalation pulmonary	ELCR _{total}	HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	HQ _{total}
POLYCHLORINATED BIPHENYLS (PCBs)	1.1E+01	2.0E-07	2.0E-07	5.1E-09	3.0E-10	4.0E-07	2.7E-01	2.8E-01	7.1E-03	2.1E-02	5.8E-01

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0414

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	μg/m ³

Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0414

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{derm} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	μg/m ³

Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00	1	0.1	1	3.5E-01	5.0E-05	1	0.1	1	5.7E-06

Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk

Based on Construction Worker 18-25 years of age

ShortForm Version 10-12

Vlookup Version v0414

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ELCR (all chemicals) = 5.3E-07

HI (all chemicals) = 9.1E-01

Oil or Hazardous	EPC	ELCR	ELCR	ELCR	ELCR		Subchronic				
Material (OHM)	(mg/kg)	ingestion	dermal	inhalation GI	inhalation pulmonary	ELCR _{total}	HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	HQ _{total}
POLYCHLORINATED BIPHENYLS (PCBs)	1.1E+01	2.0E-07	2.0E-07	5.1E-09	3.0E-10	4.0E-07	2.7E-01	2.8E-01	7.1E-03	2.1E-02	5.8E-01
ANTIMONY	5.2E+00						1.6E-02	1.6E-02	4.1E-04	1.9E-05	3.3E-02
ARSENIC	1.4E+00	9.2E-09	5.6E-09	2.4E-10	1.1E-09	1.6E-08	2.9E-03	1.7E-03	7.4E-05	2.6E-03	7.3E-03
BARIUM	1.7E+02						3.0E-03	3.0E-03	7.7E-05	1.3E-03	7.3E-03
CADMIUM	2.3E+00				1.1E-09	1.1E-09	2.8E-03	5.7E-04	7.3E-05	4.3E-03	7.8E-03
CHROMIUM (TOTAL)	3.6E+01				1.2E-07	1.2E-07	2.2E-03	2.3E-03	5.8E-05	4.5E-03	9.1E-03
LEAD	2.5E+02						2.0E-01	2.5E-02	5.3E-03	9.3E-03	2.4E-01
NICKEL	1.6E+01				2.1E-09	2.1E-09	9.9E-04	2.0E-03	2.6E-05	6.0E-04	3.6E-03
VANADIUM	2.8E+01						3.8E-03	3.8E-03	9.8E-05	1.0E-03	8.7E-03
ZINC	3.2E+02						1.3E-03	1.3E-03	3.4E-05	8.4E-03	1.1E-02
ALIPHATICS C9 to C18	4.3E+01						5.2E-05	1.1E-04	1.4E-06	2.6E-06	1.6E-04
ALIPHATICS C19 to C36	2.5E+02						5.2E-05	1.0E-04	1.3E-06		1.6E-04
AROMATICS C11 to C22	196.6						2.4E-04	8.1E-04	6.3E-06	1.5E-05	1.1E-03
AROMATICS C9 to C10	5.6						2.3E-05	4.6E-05	6.0E-07	4.2E-07	7.0E-05
BENZENE	0.043	2.1E-11	6.3E-12	5.4E-13	8.9E-14	2.8E-11	5.3E-06	1.6E-06	1.4E-07	1.6E-07	7.2E-06
ETHYLBENZENE	0.2						4.9E-06	1.5E-06	1.3E-07	8.3E-10	6.5E-06
NAPHTHALENE	0.2						3.7E-07	1.2E-06	9.6E-09	2.5E-06	4.1E-06
TOLUENE	0.5						7.7E-07	2.3E-07	2.0E-08	3.7E-09	1.0E-06
XYLENES (Mixed Isomers)	1.2						3.7E-06	1.1E-06	9.6E-08	1.1E-07	5.0E-06

Note! Cr(VI) limit is 200 mg/kg due to contact dermatitis.

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0414

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	μg/m ³

Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0414

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{derm} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	μg/m ³

Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00	1	0.1	1	3.5E-01	5.0E-05	1	0.1	1	5.7E-06
ANTIMONY						4.0E-04	1	0.1	1	2.9E-03
ARSENIC	1.5E+00	0.5	0.03	1	1.1E+01	3.0E-04	0.5	0.03	1	5.7E-06
BARIUM						7.0E-02	1	0.1	1	1.4E-03
CADMIUM					6.3E+00	5.0E-04	0.5	0.01	1	5.7E-06
CHROMIUM (TOTAL)					4.2E+01	2.0E-02	1	0.1	1	8.6E-05
LEAD						7.5E-04	0.5	0.006	1	2.9E-04
NICKEL					1.7E+00	2.0E-02	1	0.2	1	2.9E-04
VANADIUM						9.0E-03	1	0.1	1	2.9E-04
ZINC						3.0E-01	1	0.1	1	4.0E-04
ALIPHATICS C9 to C18						1.0E+00	1	0.2	1	1.7E-01
ALIPHATICS C19 to C36						6.0E+00	1	0.2		
AROMATICS C11 to C22						3.0E-01	0.3	0.1	1	1.4E-01
AROMATICS C9 to C10						3.0E-01	1	0.2	1	1.4E-01
BENZENE	5.5E-02	1	0.03	1	2.7E-02	1.0E-02	1	0.03	1	2.9E-03
ETHYLBENZENE						5.0E-02	1	0.03	1	2.6E+00
NAPHTHALENE						2.0E-01	0.3	0.1	1	8.6E-04
TOLUENE						8.0E-01	1	0.03	1	1.4E+00
XYLENES (Mixed Isomers)						4.0E-01	1	0.03	1	1.1E-01

Park Visitor - Soil: Table PS-1
Exposure Point Concentration (EPC)
Based on Visitor Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 10-12

Vlookup Version v0414

ELCR (all chemicals) = 1.1E-05

Chronic HI (all chemicals) = 1.9E+00

Subchronic HI (all chemicals) = 2.3E+00

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Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	ELCR _{ingestion}	ELCR _{dermal}	ELCR _{total}	Chronic			Subchronic		
					HQ _{ing}	HQ _{derm}	HQ _{total}	HQ _{ing}	HQ _{derm}	HQ _{total}
POLYCHLORINATED BIPHENYLS (PCBs)	1.1E+01	5.0E-06	5.2E-06	1.0E-05	8.1E-01	6.9E-01	1.5E+00	8.9E-01	5.2E-01	1.4E+00
ANTIMONY	5.2E+00				1.9E-02	1.6E-02	3.5E-02	5.2E-02	3.0E-02	8.2E-02
ARSENIC	1.4E+00	2.4E-07	1.5E-07	3.8E-07	3.4E-03	1.7E-03	5.1E-03	9.3E-03	3.3E-03	1.3E-02
BARIUM	1.7E+02				1.2E-03	1.0E-03	2.3E-03	9.6E-03	5.6E-03	1.5E-02
CADMIUM	2.3E+00				3.3E-03	5.7E-04	3.9E-03	9.2E-03	1.1E-03	1.0E-02
CHROMIUM (TOTAL)	3.6E+01				1.8E-02	1.5E-02	3.3E-02	7.3E-03	4.2E-03	1.2E-02
LEAD	2.5E+02				2.4E-01	2.5E-02	2.7E-01	6.6E-01	4.7E-02	7.1E-01
NICKEL	1.6E+01				1.2E-03	2.0E-03	3.2E-03	3.2E-03	3.8E-03	7.0E-03
VANADIUM	2.8E+01				4.5E-03	3.8E-03	8.2E-03	1.2E-02	7.2E-03	1.9E-02
ZINC	3.2E+02				1.5E-03	1.3E-03	2.8E-03	4.2E-03	2.5E-03	6.7E-03
ALIPHATICS C9 to C18	4.3E+01				6.2E-04	1.1E-03	1.7E-03	1.7E-04	2.0E-04	3.7E-04
ALIPHATICS C19 to C36	2.5E+02				1.8E-04	3.1E-04	5.0E-04	1.7E-04	2.0E-04	3.7E-04
AROMATICS C11 to C22	196.6				2.9E-03	8.1E-03	1.1E-02	7.9E-04	1.5E-03	2.3E-03
AROMATICS C9 to C10	5.6				2.7E-04	4.6E-04	7.3E-04	7.5E-05	8.7E-05	1.6E-04
BENZENE	0.043	5.3E-10	1.7E-10	7.0E-10	1.6E-05	4.0E-06	2.0E-05	1.7E-05	3.0E-06	2.0E-05
ETHYLBENZENE	0.2				5.8E-06	1.5E-06	7.3E-06	1.6E-05	2.8E-06	1.9E-05
NAPHTHALENE	0.2				4.4E-06	1.2E-05	1.7E-05	1.2E-06	2.3E-06	3.5E-06
TOLUENE	0.5				9.1E-06	2.3E-06	1.1E-05	2.5E-06	4.4E-07	2.9E-06
XYLENES (Mixed Isomers)	1.2				8.7E-06	2.2E-06	1.1E-05	1.2E-05	2.1E-06	1.4E-05

Note! Cr(VI) limit is 200 mg/kg due to contact dermatitis.

Park Visitor - Soil: Table PS-2
Equations to Calculate Cancer Risk for Visitor (Age 1-31 years)

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1-31)} * CSF$$

$$LADD_{ing(1-31)} = LADD_{ing(1-8)} + LADD_{ing(8-15)} + LADD_{ing(15-31)}$$

$$LADD_{ing(age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c-ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm(1-31)} = LADD_{derm(1-8)} + LADD_{derm(8-15)} + LADD_{derm(15-31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c-derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Vlookup Version v0414

Parameter	Value	Units
CSF	OHM specific	(mg/kg-day) ⁻¹
LADD	age/OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR ₍₁₋₈₎	100	mg/day
IR ₍₈₋₁₅₎	50	mg/day
IR ₍₁₅₋₃₁₎	50	mg/day
RAF _{c-ing}	OHM specific	dimensionless
RAF _{c-derm}	OHM specific	dimensionless
EF _{ing,derm}	0.247	event/day
ED	1	day/event
EP ₍₁₋₈₎	7	years
EP ₍₈₋₁₅₎	7	years
EP ₍₁₅₋₃₁₎	16	years
C	0.000001	kg/mg
BW ₍₁₋₈₎	17.0	kg
BW ₍₈₋₁₅₎	39.9	kg
BW ₍₁₅₋₃₁₎	58.7	kg
AP _(lifetime)	70	years
SA ₍₁₋₈₎	2431	cm ² /day
SA ₍₈₋₁₅₎	4427	cm ² /day
SA ₍₁₅₋₃₁₎	5653	cm ² /day
SAF ₍₁₋₈₎	0.35	mg/cm ²
SAF ₍₈₋₁₅₎	0.14	mg/cm ²
SAF ₍₁₅₋₃₁₎	0.13	mg/cm ²

Park Visitor - Soil: Table PS-3
Equations to Calculate Chronic Noncancer Risk for Visitor (Age 1-8 years)

Vlookup Version v0414

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
EF _{ing,derm}	0.247	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
SA	2431	cm ² /day
SAF	0.35	mg/cm ²

Park Visitor - Soil: Table PS-4
Equations to Calculate Subchronic Noncancer Risk for Visitor (Age 1-2 years)

Vlookup Version v0414

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
EF _{ing,derm}	0.428	event/day
ED	1	day/event
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
SA	1670	cm ² /day
SAF	0.35	mg/cm ²

Park Visitor - Soil: Table PS-5
Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table PS-6
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table PS-6
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
EPC - Exposure Point Concentration	chemical specific	mg/kg	
IR ₍₁₋₂₎ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-3.
IR ₍₁₋₈₎ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
IR ₍₈₋₁₅₎ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
IR ₍₁₅₋₃₁₎ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Adjusts estimated dose to conform to the relevant CSF. See Table PS-6
RAF _{NC} - Relative Absorption Factor for non-Cancer Effects	chemical specific	dimensionless	Adjusts estimated dose to conform to the relevant RfD. See Table PS-6
EF _{subchronic} - Exposure Frequency for subchronic exposure	0.428	event/day	3 events/week
EF _{chronic,lifetime} - Exposure Frequency for chronic or lifetime exposure	0.247	event/day	3 events/week, 30 weeks/year
ED - Exposure Duration	1	day/event	
EP ₍₁₋₂₎ - Exposure Period for age group 1-2	0.577	years	30 weeks
EP ₍₁₋₈₎ - Exposure Period for age group 1-8	7	years	
EP ₍₈₋₁₅₎ - Exposure Period for age group 8-15	7	years	
EP ₍₁₅₋₃₁₎ - Exposure Period for age group 15-31	16	years	
BW ₍₁₋₂₎ - Body Weight for age group 1-2, subchronic	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
BW ₍₁₋₈₎ - Body Weight for age group 1-8	17.0	kg	Ibid
BW ₍₈₋₁₅₎ - Body Weight for age group 8-15	39.9	kg	Ibid
BW ₍₁₅₋₃₁₎ - Body Weight for age group 15-31	58.7	kg	Ibid
AP _{subchronic} - Averaging Period for subchronic noncancer	0.577	years	30 weeks
AP _{chronic} - Averaging Period for chronic noncancer	7	years	
AP _{lifetime} - Averaging Period for cancer/lifetime	70	years	
SA ₍₁₋₂₎ - Surface Area for age group 1-2	1670	cm ² /day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females. MADEP 1995 Guidance for Disposal Site Risk Characterization, Appendix Table B-2.
SA ₍₁₋₈₎ - Surface Area for age group 1-8	2431	cm ² / day	Ibid
SA ₍₈₋₁₅₎ - Surface Area for age group 8-15	4427	cm ² / day	Ibid
SA ₍₁₅₋₃₁₎ - Surface Area for age group 15-31	5653	cm ² / day	Ibid
SAF ₍₁₋₂₎ - Surface Adherence Factor for age group 1-2	0.35	mg _{soil} / cm ²	All SAFs developed for ShortForm according to procedure outlined in MADEP Technical
SAF ₍₁₋₈₎ - Surface Adherence Factor for age group 1-8	0.35	mg _{soil} / cm ²	Update: Weighted Skin-Soil Adherence Factors, April 2002
SAF ₍₈₋₁₅₎ - Surface Adherence Factor for age group 8-15	0.14	mg _{soil} / cm ²	
SAF ₍₁₅₋₃₁₎ - Surface Adherence Factor for age group 15-31	0.13	mg _{soil} / cm ²	

Park Visitor - Soil: Table PS-6
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic RAF _{nc-ing}	Chronic RAF _{nc-derm}	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}
POLYCHLORINATED BI	2.0E+00	1	0.1	2.0E-05	5.0E-05	1	0.1	1	0.1
ANTIMONY				4.0E-04	4.0E-04	1	0.1	1	0.1
ARSENIC	1.5E+00	0.5	0.03	3.0E-04	3.0E-04	0.5	0.03	0.5	0.03
BARIUM				2.0E-01	7.0E-02	1	0.1	1	0.1
CADMIUM				5.0E-04	5.0E-04	0.5	0.01	0.5	0.01
CHROMIUM (TOTAL)				3.0E-03	2.0E-02	1	0.1	1	0.1
LEAD				7.5E-04	7.5E-04	0.5	0.006	0.5	0.006
NICKEL				2.0E-02	2.0E-02	1	0.2	1	0.2
VANADIUM				9.0E-03	9.0E-03	1	0.1	1	0.1
ZINC				3.0E-01	3.0E-01	1	0.1	1	0.1
ALIPHATICS C9 to C				1.0E-01	1.0E+00	1	0.2	1	0.2
ALIPHATICS C19 to				2.0E+00	6.0E+00	1	0.2	1	0.2
AROMATICS C11 to				3.0E-02	3.0E-01	0.3	0.1	0.3	0.1
AROMATICS C9 to				3.0E-02	3.0E-01	1	0.2	1	0.2
BENZENE	5.5E-02	1	0.03	4.0E-03	1.0E-02	1	0.03	1	0.03
ETHYLBENZENE				5.0E-02	5.0E-02	1	0.03	1	0.03
NAPHTHALENE				2.0E-02	2.0E-01	0.3	0.1	0.3	0.1
TOLUENE				8.0E-02	8.0E-01	1	0.03	1	0.03
XYLENES (Mixed Isome				2.0E-01	4.0E-01	1	0.03	1	0.03

Resident - Soil: Table RS-1 Exposure Point Concentration (EPC)

Based on Resident Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 10-12

Vlookup Version v0414

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Click on empty cell below and select OHM using arrow.

ELCR (all chemicals) = 1.8E-05

Chronic HI (all chemicals) = 3.1E+00

Subchronic HI (all chemicals) = 3.8E+00

Oil or Hazardous Material	EPC (mg/kg)	ELCR _{ingestion}	ELCR _{dermal}	Derm & Ing ELCR _{total}	Chronic		Derm & Ing HQ _{total}	Subchronic		Derm & Ing HQ _{total}
					HQ _{ing}	HQ _{derm}		HQ _{ing}	HQ _{derm}	
POLYCHLORINATED BIPHENYLS (PCBs)	1.1E+01	8.3E-06	8.6E-06	1.7E-05	1.3E+00	1.1E+00	2.5E+00	1.5E+00	8.7E-01	2.4E+00
ANTIMONY	5.2E+00				3.2E-02	2.7E-02	5.8E-02	8.7E-02	5.1E-02	1.4E-01
ARSENIC	1.4E+00	3.9E-07	2.4E-07	6.4E-07	5.7E-03	2.9E-03	8.5E-03	1.6E-02	5.5E-03	2.1E-02
BARIUM	1.7E+02				2.0E-03	1.7E-03	3.8E-03	1.6E-02	9.4E-03	2.5E-02
CADMIUM	2.3E+00				5.6E-03	9.5E-04	6.5E-03	1.5E-02	1.8E-03	1.7E-02
CHROMIUM (TOTAL)	3.6E+01				2.9E-02	2.5E-02	5.4E-02	1.2E-02	7.1E-03	1.9E-02
LEAD	2.5E+02				4.0E-01	4.1E-02	4.4E-01	1.1E+00	7.8E-02	1.2E+00
NICKEL	1.6E+01				2.0E-03	3.3E-03	5.3E-03	5.4E-03	6.3E-03	1.2E-02
VANADIUM	2.8E+01				7.4E-03	6.3E-03	1.4E-02	2.0E-02	1.2E-02	3.2E-02
ZINC	3.2E+02				2.6E-03	2.2E-03	4.7E-03	7.1E-03	4.1E-03	1.1E-02
ALIPHATICS C9 to C18	4.3E+01				1.0E-03	1.8E-03	2.8E-03	2.8E-04	3.3E-04	6.2E-04
ALIPHATICS C19 to C36	2.5E+02				3.1E-04	5.2E-04	8.3E-04	2.8E-04	3.3E-04	6.1E-04
AROMATICS C11 to C22	196.6				4.8E-03	1.4E-02	1.8E-02	1.3E-03	2.6E-03	3.9E-03
AROMATICS C9 to C10	5.6				4.5E-04	7.7E-04	1.2E-03	1.2E-04	1.5E-04	2.7E-04
BENZENE	0.043	8.8E-10	2.8E-10	1.2E-09	2.6E-05	6.7E-06	3.3E-05	2.9E-05	5.0E-06	3.4E-05
ETHYLBENZENE	0.2				9.7E-06	2.5E-06	1.2E-05	2.7E-05	4.7E-06	3.1E-05
NAPHTHALENE	0.2				7.3E-06	2.1E-05	2.8E-05	2.0E-06	3.9E-06	5.9E-06
TOLUENE	0.5				1.5E-05	3.9E-06	1.9E-05	4.2E-06	7.3E-07	4.9E-06
XYLENES (Mixed Isomers)	1.2				1.5E-05	3.7E-06	1.8E-05	2.0E-05	3.5E-06	2.4E-05

Note! Cr(VI) limit is 200 mg/kg due to contact dermatitis.

Resident - Soil: Table RS-3
Equations to Calculate Cancer Risk for Resident (Age 1-31 years)

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1-31)} * CSF$$

$$LADD_{ing(1-31)} = LADD_{ing(1-8)} + LADD_{ing(8-15)} + LADD_{ing(15-31)}$$

$$LADD_{ing(age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c-ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm(1-31)} = LADD_{derm(1-8)} + LADD_{derm(8-15)} + LADD_{derm(15-31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c-derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Homegrown Produce

$$ELCR_{produce} = LADD_{produce(1-31)} * CSF$$

$$LADD_{produce(1-31)} = LADD_{produce(1-8)} + LADD_{produce(8-15)} + LADD_{produce(15-31)}$$

$$LADD_{produce(age\ x)} = \frac{[OHM]_{soil} * PUF * PIR_x * RAF_{produce} * EF_{produce} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Vlookup Version v0414

Parameter	Value	Units
CSF	OHM specific	(mg/kg-day) ⁻¹
LADD	age/OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR ₍₁₋₈₎	100	mg/day
IR ₍₈₋₁₅₎	50	mg/day
IR ₍₁₅₋₃₁₎	50	mg/day
PIR ₍₁₋₈₎	12,099	mg/day
PIR ₍₈₋₁₅₎	17,809	mg/day
PIR ₍₁₅₋₃₁₎	24,420	mg/day
RAF _{c-ing}	OHM specific	dimensionless
RAF _{c-derm}	OHM specific	dimensionless
RAF _{c-produce}	OHM specific	dimensionless
EF _{ing,derm}	0.412	event/day
EF _{produce}	1.00	event/day
ED	1	day/event
EP ₍₁₋₈₎	7	years
EP ₍₈₋₁₅₎	7	years
EP ₍₁₅₋₃₁₎	16	years
C	0.000001	kg/mg
BW ₍₁₋₈₎	17.0	kg
BW ₍₈₋₁₅₎	39.9	kg
BW ₍₁₅₋₃₁₎	58.7	kg
AP _(lifetime)	70	years
SA ₍₁₋₈₎	2431	cm ² / day
SA ₍₈₋₁₅₎	4427	cm ² / day
SA ₍₁₅₋₃₁₎	5653	cm ² / day
SAF ₍₁₋₈₎	0.35	mg/cm ²
SAF ₍₈₋₁₅₎	0.14	mg/cm ²
SAF ₍₁₅₋₃₁₎	0.13	mg/cm ²
PUF	OHM specific	(mg/mg)(mg/mg) ⁻¹

Resident - Soil: Table RS-4
Equations to Calculate Chronic Noncancer Risk for Resident Child (Age 1-8 years)

Vlookup Version v0414

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD}$$

$$ADD_{produce} = \frac{[OHM]_{soil} * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
PIR	12,099	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
RAF _{nc-produce}	OHM specific	dimensionless
EF _{ing,derm}	0.412	event/day
EF _{produce}	1.00	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
SA	2431	cm ² / day
SAF	0.35	mg/cm ²
PUF	OHM specific	(mg/mg)(mg/mg) ⁻¹

Resident - Soil: Table RS-5

Equations to Calculate Subchronic Noncancer Risk for Resident Child (Age 1-2 years)

Vlookup Version v0414

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD_{subchronic}}$$

$$ADD_{produce} = \frac{[OHM]_{soil} * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
PIR	10,900	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
RAF _{nc-produce}	OHM specific	dimensionless
EF _{ing,derm}	0.714	event/day
EF _{produce}	1.00	event/day
ED	1	day/event
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
SA	1670	cm ² / day
SAF	0.35	mg/cm ²
PUF	OHM specific	(mg/mg)(mg/mg) ⁻¹

Resident - Soil: Table RS-6
Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhilation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
LADE - Lifetime Average Daily Exposure	chemical specific	µg/m ³	
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhilation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
ADE - Average Daily Exposure	chemical specific	mg/m ³	
EPC - Exposure Point Concentration	chemical specific	mg/kg	
PUF - Plant Uptake Factor	chemical specific	(mg/mg)(mg/mg) ⁻¹	See Table RS-7; (mg _{OHM} /mg _{plant})/(mg _{OHM} /mg _{soil}) ⁻¹
IR ₍₁₋₂₎ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
IR ₍₁₋₈₎ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
IR ₍₈₋₁₅₎ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
IR ₍₁₅₋₃₁₎ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
PIR ₍₁₋₂₎ = Produce Ingestion Rate for age group 1-2	10,900	mg/day	see Table RS-6
PIR ₍₁₋₈₎ = Produce Ingestion Rate for age group 1-8	12,099	mg/day	see Table RS-6
PIR ₍₈₋₁₅₎ = Produce Ingestion Rate for age group 8-15	17,809	mg/day	Ibid
PIR ₍₁₅₋₃₁₎ = Produce Ingestion Rate for age group 15-31	24,420	mg/day	Ibid
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
EF _{subchronic} - Exposure Frequency for subchronic ingestion or dermal exposure	0.714	event/day	5 days/week
EF _{chronic} - Exposure Frequency for chronic ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF _{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF _{produce} - Exposure Frequency for produce ingestion, cancer and noncancer	1.00	event/day	
ED - Exposure Duration	1	day/event	
EP ₍₁₋₂₎ - Exposure Period for age group 1-2	0.577	years	30 weeks
EP ₍₁₋₈₎ - Exposure Period for age group 1-8	7	years	
EP ₍₈₋₁₅₎ - Exposure Period for age group 8-15	7	years	
EP ₍₁₅₋₃₁₎ - Exposure Period for age group 15-31	16	years	
BW ₍₁₋₂₎ - Body Weight for age group 1-2	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
BW ₍₁₋₈₎ - Body Weight for age group 1-8	17.0	kg	Ibid
BW ₍₈₋₁₅₎ - Body Weight for age group 8-15	39.9	kg	Ibid
BW ₍₁₅₋₃₁₎ - Body Weight for age group 15-31	58.7	kg	Ibid
AP _{subchronic} - Averaging Period for subchronic noncancer	0.577	years	30 weeks
AP _{chronic} - Averaging Period for chronic noncancer	7	years	
AP _{cancer} - Averaging Period for lifetime	70	years	
SA ₍₁₋₂₎ - Surface Area for age group 1-2	1670	cm ² / day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females
SA ₍₁₋₈₎ - Surface Area for age group 1-8	2431	cm ² / day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-2.
SA ₍₈₋₁₅₎ - Surface Area for age group 8-15	4427	cm ² / day	Ibid
SA ₍₁₅₋₃₁₎ - Surface Area for age group 15-31	5653	cm ² / day	Ibid
SAF ₍₁₋₂₎ - Surface Adherence Factor for age group 1-2	0.35	mg/cm ²	All SAFs developed for ShortForm according to procedure outlined in MA DEP Technical
SAF ₍₁₋₈₎ - Surface Adherence Factor for age group 1-8	0.35	mg/cm ²	Update:Weighted Skin-Soil Adherence Factors, April 2002
SAF ₍₈₋₁₅₎ - Surface Adherence Factor for age group 8-15	0.14	mg/cm ²	
SAF ₍₁₅₋₃₁₎ - Surface Adherence Factor for age group 15-31	0.13	mg/cm ²	

Resident - Soil: Table RS-8
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-prod}	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic RAF _{nc-ing}	Chronic RAF _{nc-derm}	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	RAF _{nc-prod}	PUF
POLYCHLORINATED BI	2.0E+00	1.00	0.10	1.00	2.0E-05	5.0E-05	1	0.1	1	0.1	1	0.84
ANTIMONY					4.0E-04	4.0E-04	1	0.1	1	0.1		
ARSENIC	1.5E+00	0.50	0.03	1.00	3.0E-04	3.0E-04	0.5	0.03	0.5	0.03	1	0.05
BARIUM					2.0E-01	7.0E-02	1	0.1	1	0.1		
CADMIUM					5.0E-04	5.0E-04	0.5	0.01	0.5	0.01	1	1.9
CHROMIUM (TOTAL)					3.0E-03	2.0E-02	1	0.1	1	0.1	1	0.095
LEAD					7.5E-04	7.5E-04	0.5	0.006	0.5	0.006	0.5	0.15
NICKEL					2.0E-02	2.0E-02	1	0.2	1	0.2	1	0.38
VANADIUM					9.0E-03	9.0E-03	1	0.1	1	0.1		
ZINC					3.0E-01	3.0E-01	1	0.1	1	0.1	1	1.5
ALIPHATICS C9 to C					1.0E-01	1.0E+00	1	0.2	1	0.2		
ALIPHATICS C19 to					2.0E+00	6.0E+00	1	0.2	1	0.2		
AROMATICS C11 to					3.0E-02	3.0E-01	0.3	0.1	0.3	0.1		
AROMATICS C9 to					3.0E-02	3.0E-01	1	0.2	1	0.2		
BENZENE	5.5E-02	1.00	0.03		4.0E-03	1.0E-02	1	0.03	1	0.03		
ETHYLBENZENE					5.0E-02	5.0E-02	1	0.03	1	0.03		
NAPHTHALENE					2.0E-02	2.0E-01	0.3	0.1	0.3	0.1		
TOLUENE					8.0E-02	8.0E-01	1	0.03	1	0.03		
XYLENES (Mixed Isome					2.0E-01	4.0E-01	1	0.03	1	0.03		

Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk - Future
Based on Construction Worker 18-25 years of age

ShortForm Version 10-12
 Vlookup Version v0414

****Do not insert or delete any rows****
 Click on empty cell below and select OHM using arrow.

ELCR (all chemicals) = 2.6E-07
 HI (all chemicals) = 3.8E-01

Oil or Hazardous	EPC	ELCR	ELCR	ELCR	ELCR		Subchronic				
Material (OHM)	(mg/kg)	ingestion	dermal	inhalation GI	inhalation pulmonary	ELCR _{total}	HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	HQ _{total}
POLYCHLORINATED BIPHENYLS (PCBs)	7.4E+00	1.3E-07	1.3E-07	3.4E-09	2.0E-10	2.6E-07	1.8E-01	1.8E-01	4.7E-03	1.4E-02	3.8E-01

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0414

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	μg/m ³

Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0414

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{derm} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	μg/m ³

Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00	1	0.1	1	3.5E-01	5.0E-05	1	0.1	1	5.7E-06

Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk - Future
Based on Construction Worker 18-25 years of age

ShortForm Version 10-12

Vlookup Version v0414

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

ELCR (all chemicals) = 4.0E-07

HI (all chemicals) = 7.1E-01

Oil or Hazardous	EPC	ELCR	ELCR	ELCR	ELCR		Subchronic				
Material (OHM)	(mg/kg)	ingestion	dermal	inhalation GI	inhalation pulmonary	ELCR _{total}	HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	HQ _{total}
POLYCHLORINATED BIPHENYLS (PCBs)	7.4E+00	1.3E-07	1.3E-07	3.4E-09	2.0E-10	2.6E-07	1.8E-01	1.8E-01	4.7E-03	1.4E-02	3.8E-01
ANTIMONY	5.3E+00						1.6E-02	1.6E-02	4.2E-04	2.0E-05	3.3E-02
ARSENIC	1.4E+00	9.2E-09	5.6E-09	2.4E-10	1.1E-09	1.6E-08	2.9E-03	1.7E-03	7.4E-05	2.6E-03	7.3E-03
BARIUM	1.7E+02						3.0E-03	3.1E-03	7.9E-05	1.3E-03	7.5E-03
CADMIUM	2.4E+00				1.1E-09	1.1E-09	3.0E-03	6.0E-04	7.7E-05	4.5E-03	8.1E-03
CHROMIUM (TOTAL)	3.7E+01				1.2E-07	1.2E-07	2.3E-03	2.3E-03	5.9E-05	4.6E-03	9.2E-03
LEAD	2.6E+02						2.1E-01	2.5E-02	5.4E-03	9.5E-03	2.5E-01
NICKEL	1.6E+01				2.0E-09	2.0E-09	9.9E-04	2.0E-03	2.6E-05	6.0E-04	3.6E-03
VANADIUM	2.8E+01						3.8E-03	3.8E-03	9.8E-05	1.0E-03	8.7E-03
ZINC	2.3E+01						9.5E-05	9.6E-05	2.5E-06	6.2E-04	8.1E-04
ALIPHATICS C9 to C18	4.5E+01						5.5E-05	1.1E-04	1.4E-06	2.8E-06	1.7E-04
ALIPHATICS C19 to C36	2.6E+02						5.4E-05	1.1E-04	1.4E-06		1.6E-04
AROMATICS C11 to C22	199.4						2.5E-04	8.2E-04	6.4E-06	1.5E-05	1.1E-03
AROMATICS C9 to C10	5.6						2.3E-05	4.6E-05	6.0E-07	4.2E-07	7.0E-05
BENZENE	0.044	2.1E-11	6.4E-12	5.5E-13	9.1E-14	2.8E-11	5.4E-06	1.6E-06	1.4E-07	1.6E-07	7.4E-06
ETHYLBENZENE	0.2						4.9E-06	1.5E-06	1.3E-07	8.3E-10	6.5E-06
NAPHTHALENE	0.2						3.7E-07	1.2E-06	9.6E-09	2.5E-06	4.1E-06
TOLUENE	0.5						7.7E-07	2.3E-07	2.0E-08	3.7E-09	1.0E-06
XYLENES (Mixed Isomers)	1.2						3.7E-06	1.1E-06	9.6E-08	1.1E-07	5.0E-06

Note! Cr(VI) limit is 200 mg/kg due to contact dermatitis.

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0414

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	μg/m ³

Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0414

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{derm} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/μg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	μg/m ³

Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00	1	0.1	1	3.5E-01	5.0E-05	1	0.1	1	5.7E-06
ANTIMONY						4.0E-04	1	0.1	1	2.9E-03
ARSENIC	1.5E+00	0.5	0.03	1	1.1E+01	3.0E-04	0.5	0.03	1	5.7E-06
BARIUM						7.0E-02	1	0.1	1	1.4E-03
CADMIUM					6.3E+00	5.0E-04	0.5	0.01	1	5.7E-06
CHROMIUM (TOTAL)					4.2E+01	2.0E-02	1	0.1	1	8.6E-05
LEAD						7.5E-04	0.5	0.006	1	2.9E-04
NICKEL					1.7E+00	2.0E-02	1	0.2	1	2.9E-04
VANADIUM						9.0E-03	1	0.1	1	2.9E-04
ZINC						3.0E-01	1	0.1	1	4.0E-04
ALIPHATICS C9 to C18						1.0E+00	1	0.2	1	1.7E-01
ALIPHATICS C19 to C36						6.0E+00	1	0.2		
AROMATICS C11 to C22						3.0E-01	0.3	0.1	1	1.4E-01
AROMATICS C9 to C10						3.0E-01	1	0.2	1	1.4E-01
BENZENE	5.5E-02	1	0.03	1	2.7E-02	1.0E-02	1	0.03	1	2.9E-03
ETHYLBENZENE						5.0E-02	1	0.03	1	2.6E+00
NAPHTHALENE						2.0E-01	0.3	0.1	1	8.6E-04
TOLUENE						8.0E-01	1	0.03	1	1.4E+00
XYLENES (Mixed Isomers)						4.0E-01	1	0.03	1	1.1E-01

Park Visitor - Soil: Table PS-1
Exposure Point Concentration (EPC) - Future
Based on Visitor Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 10-12

Vlookup Version v0414

ELCR (all chemicals) = 7.1E-06

Chronic HI (all chemicals) = 1.4E+00

Subchronic HI (all chemicals) = 1.8E+00

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Oil or Hazardous Material	EPC (mg/kg)	ELCR _{ingestion}	ELCR _{dermal}	ELCR _{total}	Chronic			Subchronic		
					HQ _{ing}	HQ _{derm}	HQ _{total}	HQ _{ing}	HQ _{derm}	HQ _{total}
POLYCHLORINATED BIPHENYLS (PCBs)	7.4E+00	3.3E-06	3.4E-06	6.8E-06	5.4E-01	4.6E-01	9.9E-01	5.9E-01	3.5E-01	9.4E-01
ANTIMONY	5.3E+00				1.9E-02	1.6E-02	3.6E-02	5.3E-02	3.1E-02	8.4E-02
ARSENIC	1.4E+00	2.4E-07	1.5E-07	3.8E-07	3.4E-03	1.7E-03	5.1E-03	9.3E-03	3.3E-03	1.3E-02
BARIUM	1.7E+02				1.3E-03	1.1E-03	2.3E-03	9.9E-03	5.8E-03	1.6E-02
CADMIUM	2.4E+00				3.5E-03	5.9E-04	4.1E-03	9.6E-03	1.1E-03	1.1E-02
CHROMIUM (TOTAL)	3.7E+01				1.8E-02	1.5E-02	3.3E-02	7.4E-03	4.3E-03	1.2E-02
LEAD	2.6E+02				2.5E-01	2.5E-02	2.7E-01	6.8E-01	4.8E-02	7.3E-01
NICKEL	1.6E+01				1.2E-03	2.0E-03	3.1E-03	3.2E-03	3.7E-03	6.9E-03
VANADIUM	2.8E+01				4.4E-03	3.8E-03	8.2E-03	1.2E-02	7.1E-03	1.9E-02
ZINC	2.3E+01				1.1E-04	9.6E-05	2.1E-04	3.1E-04	1.8E-04	4.9E-04
ALIPHATICS C9 to C18	4.5E+01				6.5E-04	1.1E-03	1.8E-03	1.8E-04	2.1E-04	3.9E-04
ALIPHATICS C19 to C36	2.6E+02				1.9E-04	3.3E-04	5.2E-04	1.8E-04	2.1E-04	3.8E-04
AROMATICS C11 to C22	199.4				2.9E-03	8.2E-03	1.1E-02	8.0E-04	1.6E-03	2.4E-03
AROMATICS C9 to C10	5.6				2.7E-04	4.6E-04	7.3E-04	7.5E-05	8.7E-05	1.6E-04
BENZENE	0.044	5.4E-10	1.7E-10	7.1E-10	1.6E-05	4.1E-06	2.0E-05	1.8E-05	3.1E-06	2.1E-05
ETHYLBENZENE	0.2				5.8E-06	1.5E-06	7.3E-06	1.6E-05	2.8E-06	1.9E-05
NAPHTHALENE	0.2				4.4E-06	1.2E-05	1.7E-05	1.2E-06	2.3E-06	3.5E-06
TOLUENE	0.5				9.1E-06	2.3E-06	1.1E-05	2.5E-06	4.4E-07	2.9E-06
XYLENES (Mixed Isomers)	1.2				8.7E-06	2.2E-06	1.1E-05	1.2E-05	2.1E-06	1.4E-05

Note! Cr(VI) limit is 200 mg/kg due to contact dermatitis.

Park Visitor - Soil: Table PS-2
Equations to Calculate Cancer Risk for Visitor (Age 1-31 years)

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1-31)} * CSF$$

$$LADD_{ing(1-31)} = LADD_{ing(1-8)} + LADD_{ing(8-15)} + LADD_{ing(15-31)}$$

$$LADD_{ing(age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c-ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm(1-31)} = LADD_{derm(1-8)} + LADD_{derm(8-15)} + LADD_{derm(15-31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c-derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

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Parameter	Value	Units
CSF	OHM specific	(mg/kg-day) ⁻¹
LADD	age/OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR ₍₁₋₈₎	100	mg/day
IR ₍₈₋₁₅₎	50	mg/day
IR ₍₁₅₋₃₁₎	50	mg/day
RAF _{c-ing}	OHM specific	dimensionless
RAF _{c-derm}	OHM specific	dimensionless
EF _{ing,derm}	0.247	event/day
ED	1	day/event
EP ₍₁₋₈₎	7	years
EP ₍₈₋₁₅₎	7	years
EP ₍₁₅₋₃₁₎	16	years
C	0.000001	kg/mg
BW ₍₁₋₈₎	17.0	kg
BW ₍₈₋₁₅₎	39.9	kg
BW ₍₁₅₋₃₁₎	58.7	kg
AP _(lifetime)	70	years
SA ₍₁₋₈₎	2431	cm ² /day
SA ₍₈₋₁₅₎	4427	cm ² /day
SA ₍₁₅₋₃₁₎	5653	cm ² /day
SAF ₍₁₋₈₎	0.35	mg/cm ²
SAF ₍₈₋₁₅₎	0.14	mg/cm ²
SAF ₍₁₅₋₃₁₎	0.13	mg/cm ²

Park Visitor - Soil: Table PS-3
Equations to Calculate Chronic Noncancer Risk for Visitor (Age 1-8 years)

Vlookup Version v0414

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
EF _{ing,derm}	0.247	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
SA	2431	cm ² /day
SAF	0.35	mg/cm ²

Park Visitor - Soil: Table PS-4
Equations to Calculate Subchronic Noncancer Risk for Visitor (Age 1-2 years)

Vlookup Version v0414

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
EF _{ing,derm}	0.428	event/day
ED	1	day/event
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
SA	1670	cm ² /day
SAF	0.35	mg/cm ²

Park Visitor - Soil: Table PS-5
Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table PS-6
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table PS-6
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
EPC - Exposure Point Concentration	chemical specific	mg/kg	
IR ₍₁₋₂₎ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-3.
IR ₍₁₋₈₎ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
IR ₍₈₋₁₅₎ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
IR ₍₁₅₋₃₁₎ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Adjusts estimated dose to conform to the relevant CSF. See Table PS-6
RAF _{NC} - Relative Absorption Factor for non-Cancer Effects	chemical specific	dimensionless	Adjusts estimated dose to conform to the relevant RfD. See Table PS-6
EF _{subchronic} - Exposure Frequency for subchronic exposure	0.428	event/day	3 events/week
EF _{chronic,lifetime} - Exposure Frequency for chronic or lifetime exposure	0.247	event/day	3 events/week, 30 weeks/year
ED - Exposure Duration	1	day/event	
EP ₍₁₋₂₎ - Exposure Period for age group 1-2	0.577	years	30 weeks
EP ₍₁₋₈₎ - Exposure Period for age group 1-8	7	years	
EP ₍₈₋₁₅₎ - Exposure Period for age group 8-15	7	years	
EP ₍₁₅₋₃₁₎ - Exposure Period for age group 15-31	16	years	
BW ₍₁₋₂₎ - Body Weight for age group 1-2, subchronic	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
BW ₍₁₋₈₎ - Body Weight for age group 1-8	17.0	kg	Ibid
BW ₍₈₋₁₅₎ - Body Weight for age group 8-15	39.9	kg	Ibid
BW ₍₁₅₋₃₁₎ - Body Weight for age group 15-31	58.7	kg	Ibid
AP _{subchronic} - Averaging Period for subchronic noncancer	0.577	years	30 weeks
AP _{chronic} - Averaging Period for chronic noncancer	7	years	
AP _{lifetime} - Averaging Period for cancer/lifetime	70	years	
SA ₍₁₋₂₎ - Surface Area for age group 1-2	1670	cm ² /day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females. MADEP 1995 Guidance for Disposal Site Risk Characterization, Appendix Table B-2.
SA ₍₁₋₈₎ - Surface Area for age group 1-8	2431	cm ² / day	Ibid
SA ₍₈₋₁₅₎ - Surface Area for age group 8-15	4427	cm ² / day	Ibid
SA ₍₁₅₋₃₁₎ - Surface Area for age group 15-31	5653	cm ² / day	Ibid
SAF ₍₁₋₂₎ - Surface Adherence Factor for age group 1-2	0.35	mg _{soil} / cm ²	All SAFs developed for ShortForm according to procedure outlined in MADEP Technical
SAF ₍₁₋₈₎ - Surface Adherence Factor for age group 1-8	0.35	mg _{soil} / cm ²	Update: Weighted Skin-Soil Adherence Factors, April 2002
SAF ₍₈₋₁₅₎ - Surface Adherence Factor for age group 8-15	0.14	mg _{soil} / cm ²	
SAF ₍₁₅₋₃₁₎ - Surface Adherence Factor for age group 15-31	0.13	mg _{soil} / cm ²	

Park Visitor - Soil: Table PS-6
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic RAF _{nc-ing}	Chronic RAF _{nc-derm}	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}
POLYCHLORINATED BI	2.0E+00	1	0.1	2.0E-05	5.0E-05	1	0.1	1	0.1
ANTIMONY				4.0E-04	4.0E-04	1	0.1	1	0.1
ARSENIC	1.5E+00	0.5	0.03	3.0E-04	3.0E-04	0.5	0.03	0.5	0.03
BARIUM				2.0E-01	7.0E-02	1	0.1	1	0.1
CADMIUM				5.0E-04	5.0E-04	0.5	0.01	0.5	0.01
CHROMIUM (TOTAL)				3.0E-03	2.0E-02	1	0.1	1	0.1
LEAD				7.5E-04	7.5E-04	0.5	0.006	0.5	0.006
NICKEL				2.0E-02	2.0E-02	1	0.2	1	0.2
VANADIUM				9.0E-03	9.0E-03	1	0.1	1	0.1
ZINC				3.0E-01	3.0E-01	1	0.1	1	0.1
ALIPHATICS C9 to C				1.0E-01	1.0E+00	1	0.2	1	0.2
ALIPHATICS C19 to				2.0E+00	6.0E+00	1	0.2	1	0.2
AROMATICS C11 to				3.0E-02	3.0E-01	0.3	0.1	0.3	0.1
AROMATICS C9 to				3.0E-02	3.0E-01	1	0.2	1	0.2
BENZENE	5.5E-02	1	0.03	4.0E-03	1.0E-02	1	0.03	1	0.03
ETHYLBENZENE				5.0E-02	5.0E-02	1	0.03	1	0.03
NAPHTHALENE				2.0E-02	2.0E-01	0.3	0.1	0.3	0.1
TOLUENE				8.0E-02	8.0E-01	1	0.03	1	0.03
XYLENES (Mixed Isome				2.0E-01	4.0E-01	1	0.03	1	0.03

Resident - Soil: Table RS-1
Exposure Point Concentration (EPC) - Future
Based on Resident Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 10-12
Vlookup Version v0414

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ELCR (all chemicals) = 1.2E-05
Chronic HI (all chemicals) = 2.3E+00
Subchronic HI (all chemicals) = 3.1E+00

Oil or Hazardous Material	EPC (mg/kg)	ELCR _{ingestion}	ELCR _{dermal}	Derm & Ing ELCR _{total}	Chronic		Derm & Ing HQ _{total}	Subchronic		Derm & Ing HQ _{total}
					HQ _{ing}	HQ _{derm}		HQ _{ing}	HQ _{derm}	
POLYCHLORINATED BIPHENYLS (PCBs)	7.4E+00	5.5E-06	5.7E-06	1.1E-05	9.0E-01	7.6E-01	1.7E+00	9.9E-01	5.8E-01	1.6E+00
ANTIMONY	5.3E+00				3.2E-02	2.7E-02	5.9E-02	8.8E-02	5.2E-02	1.4E-01
ARSENIC	1.4E+00	3.9E-07	2.4E-07	6.4E-07	5.7E-03	2.9E-03	8.5E-03	1.6E-02	5.5E-03	2.1E-02
BARIUM	1.7E+02				2.1E-03	1.8E-03	3.9E-03	1.6E-02	9.6E-03	2.6E-02
CADMIUM	2.4E+00				5.8E-03	9.9E-04	6.8E-03	1.6E-02	1.9E-03	1.8E-02
CHROMIUM (TOTAL)	3.7E+01				3.0E-02	2.5E-02	5.5E-02	1.2E-02	7.2E-03	1.9E-02
LEAD	2.6E+02				4.1E-01	4.2E-02	4.5E-01	1.1E+00	8.0E-02	1.2E+00
NICKEL	1.6E+01				1.9E-03	3.3E-03	5.2E-03	5.3E-03	6.2E-03	1.2E-02
VANADIUM	2.8E+01				7.4E-03	6.3E-03	1.4E-02	2.0E-02	1.2E-02	3.2E-02
ZINC	2.3E+01				1.9E-04	1.6E-04	3.5E-04	5.2E-04	3.0E-04	8.2E-04
ALIPHATICS C9 to C18	4.5E+01				1.1E-03	1.8E-03	2.9E-03	3.0E-04	3.5E-04	6.5E-04
ALIPHATICS C19 to C36	2.6E+02				3.2E-04	5.5E-04	8.7E-04	2.9E-04	3.4E-04	6.4E-04
AROMATICS C11 to C22	199.4				4.8E-03	1.4E-02	1.9E-02	1.3E-03	2.6E-03	3.9E-03
AROMATICS C9 to C10	5.6				4.5E-04	7.7E-04	1.2E-03	1.2E-04	1.5E-04	2.7E-04
BENZENE	0.044	9.1E-10	2.8E-10	1.2E-09	2.7E-05	6.8E-06	3.3E-05	2.9E-05	5.1E-06	3.5E-05
ETHYLBENZENE	0.2				9.7E-06	2.5E-06	1.2E-05	2.7E-05	4.7E-06	3.1E-05
NAPHTHALENE	0.2				7.3E-06	2.1E-05	2.8E-05	2.0E-06	3.9E-06	5.9E-06
TOLUENE	0.5				1.5E-05	3.9E-06	1.9E-05	4.2E-06	7.3E-07	4.9E-06
XYLENES (Mixed Isomers)	1.2				1.5E-05	3.7E-06	1.8E-05	2.0E-05	3.5E-06	2.4E-05

Note! Cr(VI) limit is 200 mg/kg due to contact dermatitis.

Resident - Soil: Table RS-3
Equations to Calculate Cancer Risk for Resident (Age 1-31 years)

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1-31)} * CSF$$

$$LADD_{ing(1-31)} = LADD_{ing(1-8)} + LADD_{ing(8-15)} + LADD_{ing(15-31)}$$

$$LADD_{ing(age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c-ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm(1-31)} = LADD_{derm(1-8)} + LADD_{derm(8-15)} + LADD_{derm(15-31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c-derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Homegrown Produce

$$ELCR_{produce} = LADD_{produce(1-31)} * CSF$$

$$LADD_{produce(1-31)} = LADD_{produce(1-8)} + LADD_{produce(8-15)} + LADD_{produce(15-31)}$$

$$LADD_{produce(age\ x)} = \frac{[OHM]_{soil} * PUF * PIR_x * RAF_{produce} * EF_{produce} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Vlookup Version v0414

Parameter	Value	Units
CSF	OHM specific	(mg/kg-day) ⁻¹
LADD	age/OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR ₍₁₋₈₎	100	mg/day
IR ₍₈₋₁₅₎	50	mg/day
IR ₍₁₅₋₃₁₎	50	mg/day
PIR ₍₁₋₈₎	12,099	mg/day
PIR ₍₈₋₁₅₎	17,809	mg/day
PIR ₍₁₅₋₃₁₎	24,420	mg/day
RAF _{c-ing}	OHM specific	dimensionless
RAF _{c-derm}	OHM specific	dimensionless
RAF _{c-produce}	OHM specific	dimensionless
EF _{ing,derm}	0.412	event/day
EF _{produce}	1.00	event/day
ED	1	day/event
EP ₍₁₋₈₎	7	years
EP ₍₈₋₁₅₎	7	years
EP ₍₁₅₋₃₁₎	16	years
C	0.000001	kg/mg
BW ₍₁₋₈₎	17.0	kg
BW ₍₈₋₁₅₎	39.9	kg
BW ₍₁₅₋₃₁₎	58.7	kg
AP _(lifetime)	70	years
SA ₍₁₋₈₎	2431	cm ² / day
SA ₍₈₋₁₅₎	4427	cm ² / day
SA ₍₁₅₋₃₁₎	5653	cm ² / day
SAF ₍₁₋₈₎	0.35	mg/cm ²
SAF ₍₈₋₁₅₎	0.14	mg/cm ²
SAF ₍₁₅₋₃₁₎	0.13	mg/cm ²
PUF	OHM specific	(mg/mg)(mg/mg) ⁻¹

Resident - Soil: Table RS-4
Equations to Calculate Chronic Noncancer Risk for Resident Child (Age 1-8 years)

Vlookup Version v0414

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD}$$

$$ADD_{produce} = \frac{[OHM]_{soil} * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
PIR	12,099	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
RAF _{nc-produce}	OHM specific	dimensionless
EF _{ing,derm}	0.412	event/day
EF _{produce}	1.00	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
SA	2431	cm ² / day
SAF	0.35	mg/cm ²
PUF	OHM specific	(mg/mg)(mg/mg) ⁻¹

Resident - Soil: Table RS-5

Equations to Calculate Subchronic Noncancer Risk for Resident Child (Age 1-2 years)

Vlookup Version v0414

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc-ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc-derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD_{subchronic}}$$

$$ADD_{produce} = \frac{[OHM]_{soil} * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
[OHM] _{soil}	OHM specific	mg/kg
IR	100	mg/day
PIR	10,900	mg/day
RAF _{nc-ing}	OHM specific	dimensionless
RAF _{nc-derm}	OHM specific	dimensionless
RAF _{nc-produce}	OHM specific	dimensionless
EF _{ing,derm}	0.714	event/day
EF _{produce}	1.00	event/day
ED	1	day/event
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
SA	1670	cm ² / day
SAF	0.35	mg/cm ²
PUF	OHM specific	(mg/mg)(mg/mg) ⁻¹

Resident - Soil: Table RS-6
Definitions and Exposure Factors

Vlookup Version v0414

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhilation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
LADE - Lifetime Average Daily Exposure	chemical specific	µg/m ³	
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhilation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
ADE - Average Daily Exposure	chemical specific	mg/m ³	
EPC - Exposure Point Concentration	chemical specific	mg/kg	
PUF - Plant Uptake Factor	chemical specific	(mg/mg)(mg/mg) ⁻¹	See Table RS-7; (mg _{OHM} /mg _{plant})/(mg _{OHM} /mg _{soil}) ⁻¹
IR ₍₁₋₂₎ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
IR ₍₁₋₈₎ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
IR ₍₈₋₁₅₎ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
IR ₍₁₅₋₃₁₎ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
PIR ₍₁₋₂₎ = Produce Ingestion Rate for age group 1-2	10,900	mg/day	see Table RS-6
PIR ₍₁₋₈₎ = Produce Ingestion Rate for age group 1-8	12,099	mg/day	see Table RS-6
PIR ₍₈₋₁₅₎ = Produce Ingestion Rate for age group 8-15	17,809	mg/day	Ibid
PIR ₍₁₅₋₃₁₎ = Produce Ingestion Rate for age group 15-31	24,420	mg/day	Ibid
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
EF _{subchronic} - Exposure Frequency for subchronic ingestion or dermal exposure	0.714	event/day	5 days/week
EF _{chronic} - Exposure Frequency for chronic ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF _{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF _{produce} - Exposure Frequency for produce ingestion, cancer and noncancer	1.00	event/day	
ED - Exposure Duration	1	day/event	
EP ₍₁₋₂₎ - Exposure Period for age group 1-2	0.577	years	30 weeks
EP ₍₁₋₈₎ - Exposure Period for age group 1-8	7	years	
EP ₍₈₋₁₅₎ - Exposure Period for age group 8-15	7	years	
EP ₍₁₅₋₃₁₎ - Exposure Period for age group 15-31	16	years	
BW ₍₁₋₂₎ - Body Weight for age group 1-2	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
BW ₍₁₋₈₎ - Body Weight for age group 1-8	17.0	kg	Ibid
BW ₍₈₋₁₅₎ - Body Weight for age group 8-15	39.9	kg	Ibid
BW ₍₁₅₋₃₁₎ - Body Weight for age group 15-31	58.7	kg	Ibid
AP _{subchronic} - Averaging Period for subchronic noncancer	0.577	years	30 weeks
AP _{chronic} - Averaging Period for chronic noncancer	7	years	
AP _{cancer} - Averaging Period for lifetime	70	years	
SA ₍₁₋₂₎ - Surface Area for age group 1-2	1670	cm ² / day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females
SA ₍₁₋₈₎ - Surface Area for age group 1-8	2431	cm ² / day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-2.
SA ₍₈₋₁₅₎ - Surface Area for age group 8-15	4427	cm ² / day	Ibid
SA ₍₁₅₋₃₁₎ - Surface Area for age group 15-31	5653	cm ² / day	Ibid
SAF ₍₁₋₂₎ - Surface Adherence Factor for age group 1-2	0.35	mg/cm ²	All SAFs developed for ShortForm according to procedure outlined in MA DEP Technical
SAF ₍₁₋₈₎ - Surface Adherence Factor for age group 1-8	0.35	mg/cm ²	Update:Weighted Skin-Soil Adherence Factors, April 2002
SAF ₍₈₋₁₅₎ - Surface Adherence Factor for age group 8-15	0.14	mg/cm ²	
SAF ₍₁₅₋₃₁₎ - Surface Adherence Factor for age group 15-31	0.13	mg/cm ²	

Resident - Soil: Table RS-8
Chemical-Specific Data

Vlookup Version v0414

Oil or Hazardous Material	CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-prod}	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic RAF _{nc-ing}	Chronic RAF _{nc-derm}	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	RAF _{nc-prod}	PUF
POLYCHLORINATED BI	2.0E+00	1.00	0.10	1.00	2.0E-05	5.0E-05	1	0.1	1	0.1	1	0.84
ANTIMONY					4.0E-04	4.0E-04	1	0.1	1	0.1		
ARSENIC	1.5E+00	0.50	0.03	1.00	3.0E-04	3.0E-04	0.5	0.03	0.5	0.03	1	0.05
BARIUM					2.0E-01	7.0E-02	1	0.1	1	0.1		
CADMIUM					5.0E-04	5.0E-04	0.5	0.01	0.5	0.01	1	1.9
CHROMIUM (TOTAL)					3.0E-03	2.0E-02	1	0.1	1	0.1	1	0.095
LEAD					7.5E-04	7.5E-04	0.5	0.006	0.5	0.006	0.5	0.15
NICKEL					2.0E-02	2.0E-02	1	0.2	1	0.2	1	0.38
VANADIUM					9.0E-03	9.0E-03	1	0.1	1	0.1		
ZINC					3.0E-01	3.0E-01	1	0.1	1	0.1	1	1.5
ALIPHATICS C9 to C					1.0E-01	1.0E+00	1	0.2	1	0.2		
ALIPHATICS C19 to					2.0E+00	6.0E+00	1	0.2	1	0.2		
AROMATICS C11 to					3.0E-02	3.0E-01	0.3	0.1	0.3	0.1		
AROMATICS C9 to					3.0E-02	3.0E-01	1	0.2	1	0.2		
BENZENE	5.5E-02	1.00	0.03		4.0E-03	1.0E-02	1	0.03	1	0.03		
ETHYLBENZENE					5.0E-02	5.0E-02	1	0.03	1	0.03		
NAPHTHALENE					2.0E-02	2.0E-01	0.3	0.1	0.3	0.1		
TOLUENE					8.0E-02	8.0E-01	1	0.03	1	0.03		
XYLENES (Mixed Isome					2.0E-01	4.0E-01	1	0.03	1	0.03		



*Risk -Based Cleanup & Disposal Plan
145-155 Beech Street, Chelsea MA
MassDEP RTN 3-17917*

APPENDIX J

Engineered Cap Documentation

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 WORK OF THIS SECTION INCLUDES, but is not limited to, the following:

- A. Cast-in place concrete, including formwork, reinforcement, concrete materials, accessories mix design, placement procedures, and finishes.
 - Footings and foundation walls
 - Elevator Pits
 - Slab on Grade
 - Exterior patio and sidewalks
 - Colored/Imprinted concrete at pool, patio, entrance
- B. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, sealers, and finishes.
The extent of concrete work shown on drawings, including, but not limited to the following:

Location	thickness/	psi	reinforcing
1. Footings & Foundation Walls not exposed to weather	As shown/	3000 psi	bars
3. Interior Slab on Grade	As shown/	3000 psi	Nylon fiber
4. Interior Slab on Deck (Lt/ Wt. Concrete, 115 pcf)	As shown/	3000 psi	WWF
5. Exterior Slab on Grade / Sidewalks exposed to freezing & deicing [IBC 2009 table 1904.2.2(1)]	As shown/	4500 psi w/air	WWF
6. Exterior Colored/Imprinted concrete	As shown/	4500 psi w/air	WWF
7. Interior Colored/Imprinted concrete	As shown/	4500 psi	WWF
- C. Vapor Barrier installed under all interior slabs on grade, etc.
Vapor Barrier will be placed on top of Base Course, directly under the slab. The slab must be “wet cured” for a minimum of seven (7) days and it is the responsibility of the Construction Manager or General Contractor to monitor and document the curing process. Ensure non-staining products and ensure thorough, consistent coverage during “wet curing” process.
Vapor Barrier will be taped and sealed at all overlapping joints and at all penetrations with approved POLYETHYLENE SPLICING TAPE.

Vapor Barrier shall be carried up the foundation wall and be lapped on top of the wall (under the pressure treated sill and sill seal) and up face of exterior sheathing. Refer to details in drawings for further information.

1.2 Related Documents:

- A. Drawings, Specifications, Division 1 and Contract
 1. Section 01 35 20 LEED/Environmental Requirements
 2. Section 01 56 50 Construction Waste Management Program
- B. Geotechnical Report: See Appendix A.

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1.3 QUALITY ASSURANCE:

- A. Comply with provisions American Concrete Institute 318 “Building Code Requirements for Reinforced Concrete” and 301 “Structural Concrete for Buildings” except where more stringent requirements are shown or specified.
- B. Form all footing and foundations. Unformed placement of concrete is not allowed.
- C. Conform to ACI 305R when concreting during hot weather.
- D. Conform to ACI 306R when concreting during cold weather.

1.4 Pre-placement meeting(s) shall be held at the project site, prior to installation of concrete.

Refer to Section 01 31 00 - Pre-Installation Criteria.

The attendees shall include:

General Contractor Project Manager and Superintendent
Placement Subcontractor and Foreman
Concrete Supplier
Structural Engineer and/or Architect

- A. Meeting #1 - Pre-foundation placement.
All footing excavations shall be inspected as described in Section 01010 prior to placement of Concrete.
- B. Meeting #2 - Pre-slab placement.
All below slab excavations, vapor barriers, insulation (at Guestwing) and fill shall be inspected as described in Section 01010 prior to placement of Concrete.

1.5. Submittals:

- A. Provide Mix designs including cylinder breaks for the specific mix. Concrete testing reports from previous projects with similar Mix designs must be submitted in accordance with ACI specifications. Provide designs for each type of concrete to be used on the project.
- B. Provide data sheets for aggregates, fiber reinforcing, etc. to be incorporated into the concrete.
- C. Special additives for curing acceleration, curing retardation, etc. must be approved in writing by the Structural Engineer prior to placement.

D. LEED Submittals:

- 1. Product Data for products having recycled content with documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
- 2. Product Data for building materials and products having been manufactured, harvested and extracted from regional materials.
- 3. Include statement indicating costs for each product having recycled content.

PART 2 - PRODUCTS

2.1 FORM MATERIALS:

- A. Forms for Concrete Surfaces: Plywood, lumber, metal or other acceptable material.
- B. Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces.

2.2 REINFORCING MATERIALS:

- A. Reinforcing Bars: ASTM A-615 Grade 60, deformed.
- B. Welded Wire Fabric: Plain cold-drawn welded steel wire, ASTM A-185.

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- C. Provide metal bolster, chairs and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Clay bricks, blocks, stones, etc are not acceptable.
- D. Synthetic fiber reinforcing for slabs: Virgin nylon monofilament fiber reinforcement additive conforming to ASTM C-116.

2.3 Concrete Materials:

- A. Portland Cement: ASTM C 150, Type II.
- B. Normal Weight-Aggregates: ASTM C33, with maximum 1 1/2" for footing and other mass concrete and 3/4" maximum for other concrete.
- C. Light Weight-Aggregates: ASTM C330, 3/4" nominal maximum aggregate size for slabs on deck.
- D. Water: Clean and not detrimental to concrete.
- E. Calcium Chloride: Not permitted.
- F. Admixtures: Do not use any additives without prior written approval from the Architect or Structural Engineer.

2.4 Accessories:

- A. Provide minimum 10 mil polyethylene vapor barrier with approved polyethylene splicing tape cover over prepared sub-base material for floor slabs as indicated on the drawings.
- B. Provide base course for all floor slabs of evenly graded natural gravel 3/8" maximum to 1/8" minimum (pea gravel).
- C. Non-shrink Cement Grout Below Column Base Plates: Non-metallic, flowable, high strength (4000 psi min at 7 days) conforming with CRD-C 621.
- D. Membrane Curing Compound: ASTM C309.
- E. Absorptive Mats: ASTM C171.
- F. Bonding Agent: Polymer resin emulsion.

2.5 Proportioning and Design of Mixes:

- A. Use proprietary standard design mix that meets the following qualities and furnish satisfactory evidence of such conformance prior to placement of concrete. Accompany each mixer truck with a delivery ticket noting type of concrete and materials and time of batching. Note placement location and time of each load on these tickets and file all tickets on the job site.
- B. Concrete: Proportion to design strengths indicated on drawings.

2.6 Concrete Mixes:

- A. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified:
 - 1. When air temperature is between 85 degrees F and 90 degrees F reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.
 - 2. See Part 1, Section 1.1.B
 - 3. Concrete with excessive slumps will not be placed. Slump will be taken at the truck prior to discharge into pumps (if applicable).

2.7 Composite Waterproofing:

- A. Provide Type 1 Volclay panels around entire exterior of elevator pit including top and side of footing and walls to form a monolithic waterproofing membrane.
 - 1. Sodium Bentonite Content: 1 lb./ft²
 - a. Granular Size: 90% passing 20 Sieve, 10% passing 200 Sieve
 - b. Granular Type: 90% Montmorillinite, 10% Volcanic Sediment

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2. Dry Thickness: 0.187 inch
3. Panel Size: 4 feet x 4 feet
4. Typical Panel Weight: 18 lbs.
5. Permeability: ASTM D 5084 1×10^{-9} cm/sec.
6. Puncture Resistance: ASTM D 781 95 lbs.

- B. Manufacturers recommended accessories required for complete installation.
- C. Vapor Barrier: Vapor Barrier shall be minimum 10 mil thickness polyethylene sheet materials. Installation shall be in accordance with manufacturer's recommendations.

All joints shall be lapped a minimum of 6" and sealed with approved polyethylene splicing tape as recommended by the manufacturer.

All penetrations, piping, ducts, etc. shall be lapped and sealed with approved polyethylene splicing tape.

2.8. IMPRINTED INTEGRAL COLORED CONCRETE

- A. Acceptable Manufacturer: Bomanite Corp., which is located at: 232 S. Schnoor ; Madera, CA 93637; Toll Free Tel: 800-854-2094; Tel: 559-673-2411; Fax: 559-673-8246; Web: www.bomanite.com. Or approved equivalent.
- B. Color: Integral Color
1. Integral Coloring Admixture: Integral Color by Bomanite Corporation, synthetic oxide pigment, meeting ASTM C979 and C494.
 2. Color: As manufactured by Bomanite or approved equivalent. Submit color samples for selection.
- C. Imprinting Tools:
1. Mat type imprinting tools for texturing freshly placed concrete, in pattern/texture as selected by Architect or as scheduled.
 2. Imprinting tools used in the execution of this project shall be manufactured by Bomanite Corporation or approved equivalent.
 3. Bomacron Textures and Patterns:
 - a. As manufactured by Bomanite or approved equivalent. Submit stamping pattern samples for selection.
- D. Release Agent Selection:
1. Liquid Release Agent. Clear color.
 - a. Bomanite Liquid Release.
- E. Form and install colored concrete pool deck per manufacturer's recommendations.

2.9. Admixtures:

- A. AIR ENTRAINMENT – 6% (+/- 1%) IN ALL EXTERIOR SLABS AND EXPOSED RETAINING WALLS, PER ASTM C 260.

PART 3 - EXECUTION

3.1 Forms:

- A. Arrange and assemble formwork which is readily removable without damage to cast-in-place concrete surfaces and adjacent materials.
- B. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work. Support brace and maintain formwork to support vertical and lateral loads until such loads can be supported by concrete.

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- C. Use factory fabricated, adjustable length, removable or snap-off metal form ties. Install required amount of ties as specified in the manufacturer's literature.
 - D. Provide PVC sleeves openings in concrete formwork to accommodate work of other trades, schedule 40 PVC.
 - E. Expansion joint material, asphalt impregnated formed felt; thickness as indicated; depth as required for concrete section being placed, position flush with surface of concrete. Material shall be compatible with joint sealant.
 - F. Use form liners for all exposed foundation walls in excess of 24".
- 3.2 Placing Reinforcement:
- A. Accurately position, support and secure reinforcement against displacement by formwork, construction or concrete placement operations.
 - 1. All bars shall be continuous in longest length possible with minimum 36 bar diameter laps. Reinforcing shall not be continuous through control joints, except at footings.
 - 2. Bent corner reinforcing at all inside and outside corners shall be provided to lap and match horizontal reinforcement.
 - 3. Minimum coverage for any reinforcing steel shall be as per ACI.
 - 4. Welding for fabrication and installation is not permitted.
 - B. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least two full mesh and lace splices with wire.
- 3.3 Installation of embedded Items:
- A. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete.
- 3.4 Preparation of Form Surfaces:
- A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- 3.5 Form Cleaning:
- A. Clean forms to remove foreign matter within forms.
 - B. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.
- 3.6 Concrete Placement:
- A. Comply with American Concrete Institute 304, and herein specified.
 - B. Install vapor barrier under interior slabs on grade. Lap joints minimum 6 inches and seal with approved polyethylene splicing tape. (Refer to 1.1.C. of this Section for wet curing process).
 - C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness.
 - D. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding or tamping (except for slabs).
 - E. Deposit and consolidate concrete slabs in a continuous operation.
 - F. Bring slab surfaces to correct level with straightedge and strike-off. Use bull floats or darbies to smooth surface, free of humps and hollows.
 - G. Maintain mesh reinforcing in approximately the middle of slab during concrete placement operations.
 - H. Protect concrete work from physical damage or reduced strength, which could be caused by frost, freezing actions, or low temperatures.
 - I. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.

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- J. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with American Concrete Institute 305R.
- K. When cold weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with American Concrete Institute 306R.

3.7 Finish of Formed Surfaces:

- A. Concrete surfaces not exposed-to-view in the finish work have texture imported by form facing material used. Repair and patch tie holes and defective areas and chip off fins and other projections and recesses exceeding 1/4" in height.
- B. At exposed garage concrete columns:
CONCRETE FINISH: AFTER STRIPPING OF FORMWORK, SURFACES SHALL BE CLEANED, WALL TIES REMOVED, FINS AND OTHER PROJECTIONS OF 1/2" REMOVED. WET RUBBED AND/OR DRY GRINDING REQUIRED TO ACHIEVE A SMOOTH FINISH. REPAIR AND PATCH HOLES LARGER THAN A DIME.

3.8 Monolithic Slab Finishes:

- A. Apply float finish to monolithic slab surfaces. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power driven floats, finished to a tolerance of Ff20/FI 13.
- B. Provide 1/2" pitch in 4'-0" diameter of all floor drains.
- C. Provide broom finish surface in laundry room for installation of waterproofing membrane flooring.

3.9 Concrete slab Curing and Protection:

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. See part 1.3 of this specification section for additional information. Specific criteria for the project shall be established at the Pre-Placement meeting held at the project site.
- B. Provide moisture curing or use moisture-retaining covers to cure concrete surfaces at interior slab on grade, by one of the following methods for a period of 7 days.
 - 1. Cover concrete surface with non-staining absorptive cover, thoroughly saturating cover with water and keeping continuously wet.
 - 2. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width.

3.10 Removal of Forms:

- A. Form work may not be removed in less than 36 hours or until concrete has attained sufficient strength to carry loads.

3.11 Concrete Surface Repairs:

- A. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case, to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
- B. Excessive honeycomb or embedded debris in concrete is unacceptable.

3.12 Composite Waterproofing:

- A. Install Composite Waterproofing at Elevator Pit per manufacturer's installation instructions, providing accessories necessary for complete installation.

**Hilton Homewood Suites
Lawrenceville LLC**
Chelsea, MA
Project #301252



Project Specification
September 4, 2014
Issued for Foundation Permit

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END OF SECTION

ASPHALT PAVEMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

Work under this Section consists of furnishing all labor, materials and equipment required to complete full-depth asphalt paving and surfacing work defined by the Documents.

1.2 STANDARDS

Comply with applicable provisions and recommendations of the following except where otherwise shown or specified.

ASTM D1557-78, "Tests for Moisture - Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and 18 inch Drop." (Modified proctor).

MASSDOT, "Standard Specifications for Highways and Bridges", 1988

USDOT, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects"

PART 2 - PRODUCTS

2.1 GENERAL CRITERIA

Samples and certifications of construction materials are to be submitted for record and approval. No materials are to be delivered or placed without the Engineer's prior approval.

After basic pavement drainage patterns have been established the base course pavement is to be immediately placed so as to provide construction vehicle access. No course is to be placed on prior pavement unless the substrate surface is cleaned and free of all embedded silt, clay or other debris, and tack coated to insure course adhesion.

No grade cuts are to be made in road bed areas unless base course pavement placement immediately follows, insuring that surface waters will not damage or disturb any possible existing sub-grade native clays.

The Contractor is completely responsible for repairing damage to any site pavement caused by his operations. Permanent repairs are to be made promptly upon notification of damage and conform to criteria contained in this Section of the Specifications.

2.2 MATERIALS

The subgrades under roadways and parking areas are, in general, to consist of a minimum of one (1') foot thickness of Class "G" compacted fills and six (6) inches of compacted quarry process road stone. The subgrades are to be brought to the required finished grades and elevations and compacted to 95% of the maximum density determined in accordance with ASTM D 1557-78, using the particular type fill shown on the Drawings and in accordance with the details specified in other Sections of these Specifications. The Contractor is to place no stone, bituminous materials or concrete on any subgrade until it has been inspected and approved by the Engineer.

The Contractor is to comply with the requirements of applicable concrete sections under other Divisions of these Specifications for all concrete materials, admixtures, bonding materials, curing materials, methods of placing and other requirements.

Mineral Filler for bituminous concrete and sheet asphalt is to be dolomite, traprock, blast furnace slag or other inert mineral matter from approved sources, free from lumps and foreign materials and is to be of the following quality and fineness: Not less than 95% is to pass a No. 100 sieve and not less than 85% is to pass a No. 200 sieve.

Bituminous Concrete Stabilized Base is to consist of Soil Aggregate and Bituminous Material uniformly mixed as hereinafter specified and placed on the previously prepared subgrade. The gradation of total aggregate (coarse plus fine, plus filler if required) is to be as follows:

<u>Sieve Size</u>	<u>Weight Percent Passing</u>
2 Inch	100
1 1/2 Inch	90-100
1 Inch	80-100
3/4 Inch	65-95
No. 4	25-60
No. 8	20-50
No. 50	8-30
No. 200	4-12

Material passing the No. 200 sieve may consist of fine particles of the aggregate or mineral filler or both. Material passing the No. 40 sieve is to be non-plastic when tested in accordance with the requirements of current AASHTO Designation T90. The required mixing time is to be 45 seconds. The stability of the completed mixture as determined by the means of the Marshall Apparatus is to have a value of not less than 1,000 lbs. at 140°F. The gradation of total aggregate (coarse plus fine, plus filler if required) is to be as follows:

<u>U.S. Sieve Size</u>	<u>Weight Percent Passing</u>
1/2 Inch	100
3/8 Inch	80-100

No. 4	55-75
No. 8	30-60
No. 50	10-30
No. 200	4-8

PART 3 - EXECUTION

3.1 CARE AND RESTORATION OF PROPERTY

All pavements which have been damaged by the Contractor's operations during any part of construction work after paving, shall be restored to a condition at least equal to that in which they were completed.

3.2 PREPARATION OF SUBGRADE IN CUT AREAS

If after excavation to the proposed subgrade elevation, the in-situ material is determined by the Engineer to be unsuitable, the Contractor shall excavate an additional 1 foot and backfill with AASHTO #1 compacted to 95 percent of maximum dry density.

The Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc. from areas upon which sub-base and pavement material will be placed. The subgrade shall be shaped as indicated on the Drawings and shall be compacted to 95 percent of maximum dry density, by proof rolling with a minimum 10-ton steel drum roller prior to placement of any paving base materials.

Layers shall not exceed nine (9) inches in thickness before compaction. The layers shall be slightly convex toward the center. Layers shall be compacted to 95 percent of the maximum dry density of the particular material used. Compaction shall be by proof rolling with a minimum 10-ton vibratory roller prior to placement of any paving base materials. A minimum of ten passes shall be made.

3.3 FINAL SUBGRADE PREPARATION

Subgrades for pavements are not to vary more than 1/4 inch from the specified grade and cross section. Variations within the above specified tolerances are to be compensated so that the average grade and cross sections specified are met.

The subgrade is to be maintained in a satisfactory condition and properly finished to the satisfaction of the Engineer. No material is to be placed upon the prepared subgrade until it has been inspected for proper depth and compaction and has met the approval of the Engineer. No materials are to be placed on the prepared subgrade if the subgrade is wet or frozen.

3.4 PLACEMENT OF BITUMINOUS CONCRETE STABILIZED BASE (MIX No. I-2)

The stabilized base is to be placed in the manner described herein. The material is to leave the plant at a temperature sufficient for workability under prevailing conditions. However, the temperature of the

mixtures when laid is not to be less than 250°F. The material is to be laid in one lift, using a Jersey Spreader Box or other equipment approved by the Engineer, and the thickness is to be sufficient to obtain a compacted thickness as indicated on the plans. Initial rolling of the base course to be compacted is to be done with at least two rollers, one of which is to be a three-wheel roller of ten tons minimum and the other two or three axle tandem roller of eight tons minimum, operating immediately in back of the spreader. The second, third and final rolling are to be performed with a two or three axle tandem roller until the mixture is thoroughly compacted to the satisfaction of the Engineer.

When the air temperature is below 50°F all trucks transporting Bituminous Concrete Stabilized Base Material are to be covered with canvasses. Also, no stabilized base material is to be laid unless the temperature is above 25°F and rising.

Traffic may be carried on the base course only if absolutely necessary and then only if approved by the Engineer. The Contractor will be responsible for the maintenance of the base course at all times it is exposed to traffic. Immediately prior to construction of subsequent pavement surface thereon, the base course is to be cleaned of all loose and foreign materials and all damaged areas are to be repaired to the satisfaction of the Engineer.

After the Bituminous Concrete Base Course has been placed, all manholes, valve boxes, catch basins, and driveway entrances (where curb exists) are to be ramped with stabilized base in a manner satisfactory to the Engineer.

If, prior to the placing of the surface pavement, material has to be removed because it has broken up, the Contractor is to remove the bad areas to the limits as specified by the Engineer. Once this area has been dug out, the Contractor is to furnish and lay bituminous stabilized base and compact as specified above.

3.5 PERMANENT PAVING

After the Engineer has approved the Base Course, the Surface Course of Bituminous Concrete Mix No. I-5 is to be constructed to the thickness shown on the Drawings.

Where the air temperature is below 50°F, all trucks transporting bituminous concrete surface course material are to be covered with canvasses. Also, no surface course material is to be laid unless the temperature is above 40°F and rising.

Shoulders, slopes and ditches shall be shaped with suitable machinery supplemented by hand labor to reasonably smooth surfaces that will be in keeping with the character of the adjacent terrain and merge into it without any noticeable break.

The Contractor shall remove and dispose of all temporary pavement. All loose or damaged material in the existing pavement outside of trench pavement shall be removed and a leveling course, as hereinbefore specified, shall be installed. A leveling sub-base shall also be installed at depths and locations, as directed by the Engineer, to fill existing holes and depressions, or to improve roadway

crowns. Leveling course quantities used to repair trench paving shall not be included for compensation.

Prior to permanent paving, the Contractor shall adjust all existing manholes, catch basins, valve boxes, curb boxes, and utility covers, etc. to conform to the final pavement grade. The Contractor shall thoroughly clean surfaces of existing pavement, which will be bonded to permanent paving.

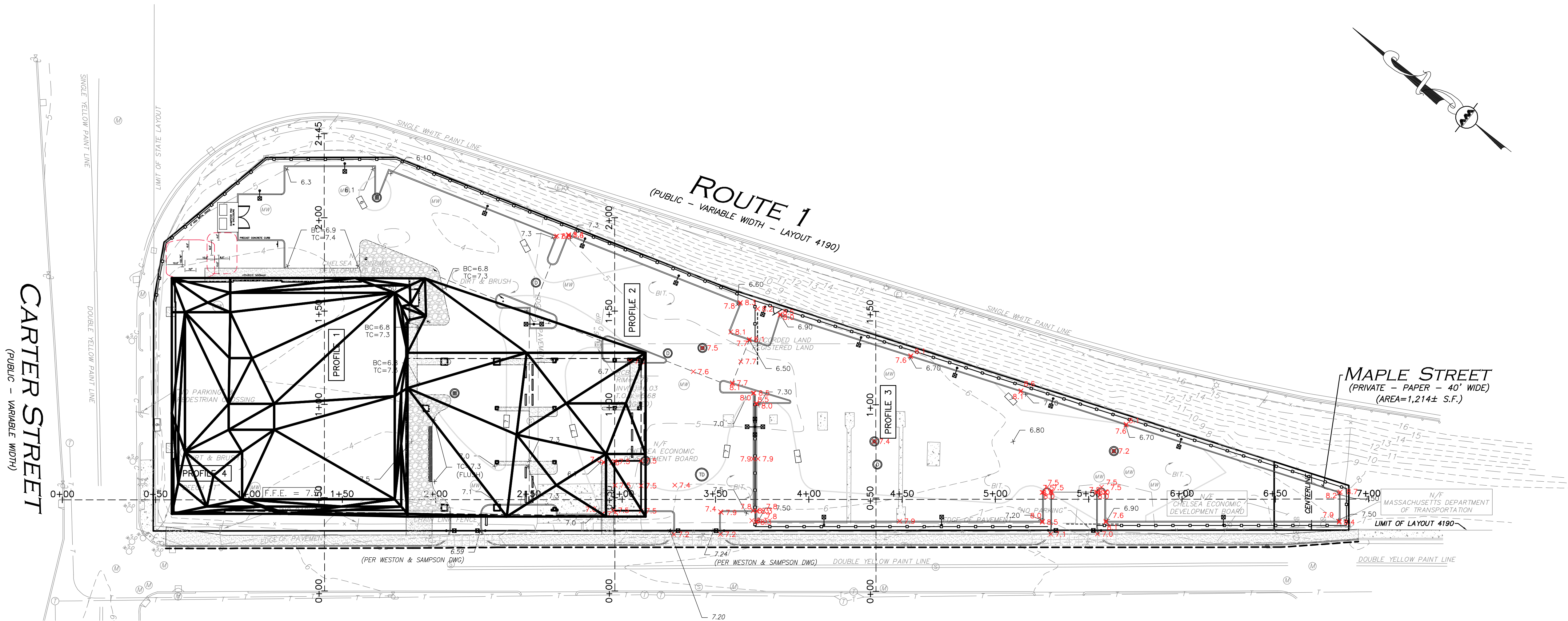
All base course paving shall be dry and thoroughly cleaned of foreign or loose material; a prime or tack coat, shall be applied at the rate of 0.05 to 0.15 gallons per square yard of pavement, depending upon the condition of the existing surface. All casting and edge stones will be protected from the tack coat.

Longitudinal and transverse joints in curb-to-curb paving shall be offset a minimum of 6 inches from trench paving of definable previously existing joints. The maximum length of longitudinal joints shall be such that the temperature of the mixture at the joint shall not be less than 150°F, when the abutting mixture is placed.

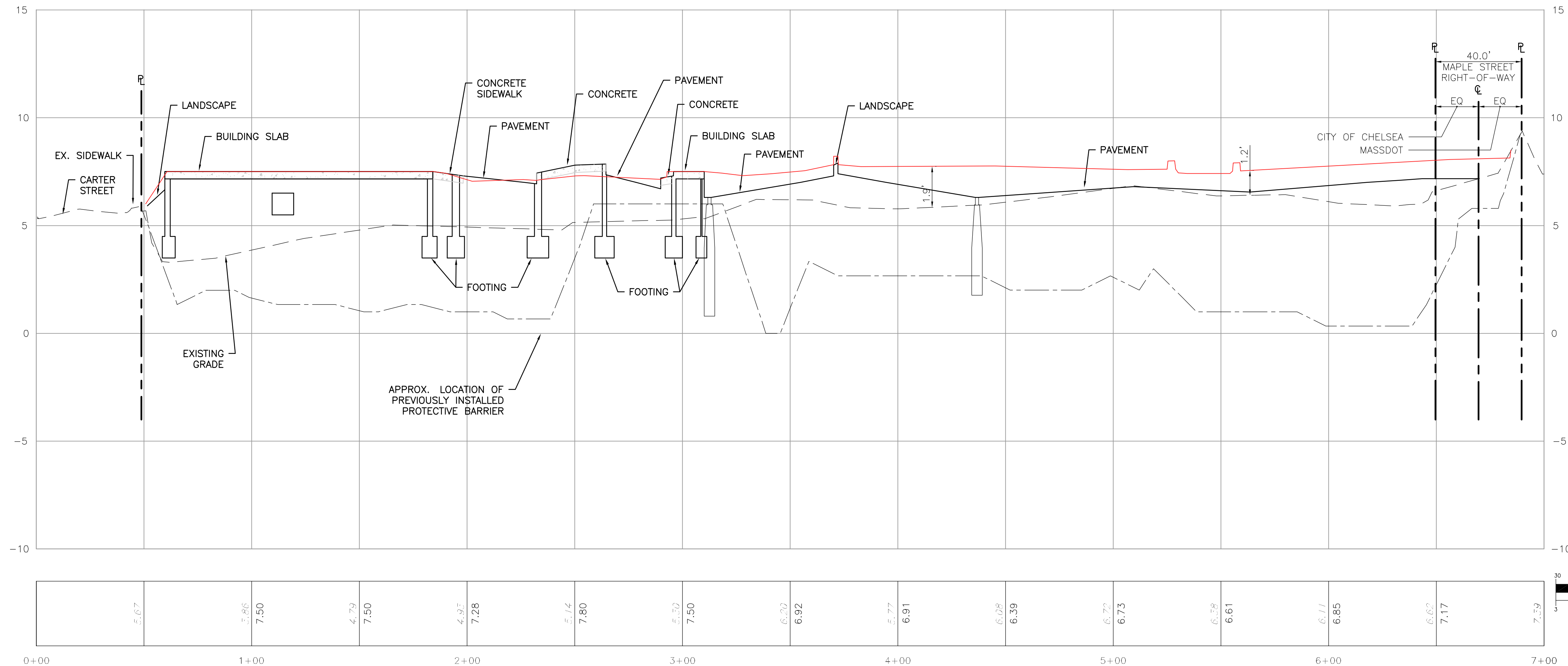
3.6 MAINTENANCE OF PAVING

The Contractor shall inspect and maintain pavement placed under this Contract until the expiration of the one-year guarantee period and shall identify and promptly fill with similar material all depressions and holes that may occur so as to keep the pavement in a safe and satisfactory condition for traffic.

END OF SECTION



PROFILE 4



ISSUED FOR
REVIEW
04/01/2015

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV DATE DESCRIPTION
APPLICANT/OWNER:
LAWRENCEVILLE, LLC
C/O JOHN STEBBINS
P.O. BOX 4430
MANCHESTER, NH 03108

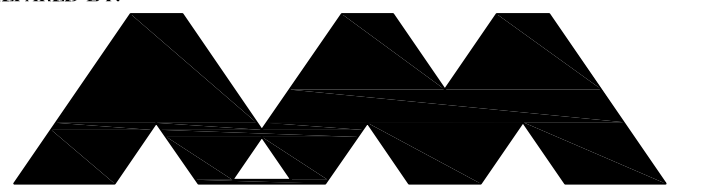
PROJECT:
LAWRENCEVILLE, LLC
A 152 GUESTROOM
FULL SERVICE HOTEL
145 Beech Street - Chelsea, MA

PROJECT NO. 1362-07 DATE: 03/31/15

SCALE: AS SHOWN DWG NAME: 1362-07 PROFILES

DESIGNED BY: MAM CHECKED BY: RC

PREPARED BY:



ALLEN & MAJOR
ASSOCIATES, INC.

civil & structural engineering • land surveying
environmental consulting • landscape architecture
www.allenmajor.com

250 COMMERCIAL STREET
SUITE 1001
MANCHESTER, NH 03101
TEL: (603) 627-5500 FAX: (603) 627-5501
WOBBURN, MA • LAKEVILLE, MA • MANCHESTER, NH

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SITE PLAN & PROFILE CP-2

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April 14, 2015

RE: Certification of Financial Assurance
Proposed Hotel
145-155 Beech Street
Chelsea, MA
RTN 3-17917

Lawrenceville, LLC will be constructing an engineered cap at 145-155 Beech Street in Chelsea, Massachusetts under a Risk Based Cleanup Plan. The engineered cap will require the implementation of a long-term monitoring and maintenance plan. Lawrenceville, LLC has the financial resources and ability to conduct the long-term monitoring and maintenance required by the plan.

Very truly yours,

Lawrenceville, LLC



Mark R. Stebbins
Managing Member



*Risk -Based Cleanup & Disposal Plan
145-155 Beech Street, Chelsea MA
MassDEP RTN 3-17917*

APPENDIX K

Long Term Monitoring & Maintenance Plan

Long-Term Monitoring & Maintenance Plan (LTMMMP)

Cap Construction

Pursuant to the requirements of 40 CFR 761.61(a)(7) and the Massachusetts Contingency Plan (MCP), the engineered cap must be maintained in accordance with the following LTMMMP, to reduce or eliminated exposure of human and environmental receptors to PCB-contaminated soil remaining at 145 – 155 Beech Street in Chelsea, MA (the Site)::

- 1) The new hotel building will be constructed on piers, with the base of the concrete floor of the building at or near grade. The floor shall consist of a minimum of 4 inches of cast-in-place reinforced concrete on top of a 6 inches gravel base above 12 inches gravel borrow for a total cap thickness of at least 22 inches. A 10 mil vapor barrier will be installed below the concrete floor of the building. Portions of exterior areas of the Site will be landscaped. All landscaped areas will be constructed with a minimum of 3 feet of clean fill which is composed of at least 6 inches of loam on top of general fill.
- 2) The remaining exterior site areas are asphalt or concrete paved. Asphalt will be placed at a minimum thickness of 4 inches on top of 6 inches gravel base and 12 inches gravel borrow for a total cap thickness of at least 22 inches. Concrete will be placed at a minimum thickness of 6 inches on top of 6 inches gravel base and 12 inches gravel borrow for a total cap thickness of at least 24 inches. .

Cap Maintenance

The following activities are required to maintain the integrity of the cap. In the event that activities prohibited in this section must be undertaken, a Massachusetts Licensed Site Professional must be involved to direct and oversee the activities.

A. Maintain all asphalt pavement and concrete pavement such that the integrity of each is not compromised as follows:

- 1) If replacement of asphalt or concrete surfaces is required, it shall be limited to the material to be replaced such that the underlying soil is not significantly disturbed (12 inches deep or less below top of surface being removed) and the surface material is immediately repaired or replaced with a comparable barrier (initiated within 72 hours).
- 2) No excavation shall be performed to a depth greater than 22 inches beneath the surface of paved areas.
- 3) Prohibit any such activities that result, or could result, in compromising the structural integrity of asphalt pavement, or concrete pavement.

B. Maintain all interior building floors such that their integrity is not compromised as follows:

- 1) If replacement of the concrete slab is required, it shall be limited to the material to be replaced such that the underlying soil is not significantly disturbed (12 inches deep or less below the top of the concrete surface being removed) and the surface material is immediately repaired or replaced with a comparable barrier (initiated within 72 hours).

- 2) Any penetration or breaching of the vapor barrier shall be immediately repaired or replaced with a comparable barrier (initiated within 72 hours).
- 3) No excavation shall be performed to a depth greater than 22 inches beneath the surface of building floor.
- 4) Prohibit any such activities that result, or could result, in compromising the structural integrity of building floors.

C. Maintain all landscaped areas such that their integrity is not compromised as follows:

- 1) If vegetation is to be planted or removed, excavation and/or removal of existing root systems shall not extend beyond 2 feet below existing grade.
- 2) Prohibit any excavation to a depth greater than 3 feet in landscaped areas.
- 3) Prohibit any activities that result, or could result, in the erosion of soil in any unpaved area.
- 4) Prohibit planting any deep-rooted vegetation (i.e., with roots typically extending greater than 3 feet below grade).
- 5) Prohibit removal of overburden soil that reduces the depth of clean fill to less than 3 feet.

Cap Inspections

Perform semi-annual inspections and associated record keeping activities to confirm that the cap is being properly maintained to prevent exposure. Particular attention is drawn to the following:

- 1) Best management practices.
- 2) Prompt repair of any damage to the cap, whatever the cause, to substantially restore the cap to its original design condition (initiated within 72 hours).
- 3) Performance of frequent and short watering of landscape vegetation to encourage shallow root growth is recommended.
- 4) Prompt removal of any deep-rooted indigenous species identified during routine inspections.

Deed Restriction

The above requirements will be recorded on the property in a Notice of Activity and Use Limitation (AUL) at the Suffolk County Registry of Deeds. The AUL will be prepared and filed within 60 days of completion of cleanup activity, as required in 40 CFR 761.61(8)(i), and in accordance with the requirements of the MCP 310 CMR 40.0000. The AUL will be maintained, and the LTMMP will continue to be implemented, in perpetuity, or until such time as additional response actions allow the modification or removal of the AUL and LTMMP in accordance with all applicable laws and regulations in force at the time.

Soil Management Plan

A Soil Management Plan must be prepared by a Massachusetts Licensed Site Professional (LSP) and implemented prior to the commencement of any activity which is likely to disturb contaminated soil, the top of which is located at 22 inches to 3 feet below surface grade within the AUL area. The Soil Management Plan should describe appropriate soil excavation, handling, storage, transport, and disposal procedures and include a description of the engineering controls and air monitoring procedures necessary to ensure that workers and receptors in the vicinity are not affected by fugitive dust or particles. On-Site workers must be informed of the requirements

of the soil management plan, and the Plan must be available on-site throughout the course of the project.

Health and Safety Plan

A Health and Safety Plan must be prepared by a certified Industrial Hygienist or other qualified individual sufficiently trained in worker health and safety requirements and implemented prior to the commencement of any activity which is likely to disturb contaminated soil, the top of which is located at 22 inches to 3 feet below surface grade within the AUL area. The Health and Safety Plan should specify the type of personal protection (i.e., clothing, respirators), engineering controls, and environmental monitoring (if any) necessary to prevent worker exposures to contaminated soil through dermal contact, ingestion, and/or inhalation. Workers must be informed of the requirements of the Health and Safety Plan, and the plan must be available on-site throughout the course of the project.

Communications

The documentation of all maintenance and monitoring activities conducted under this LTMMP will be maintained in the following location:

Office of Stebbins Lazos & Van Der Beken P.A.
66 Hanover Street, Suite 301
Manchester, NH 03101

Interested stakeholders can contact the following if they wish to review this documentation:

David P. Van Der Beken
Stebbins Lazos & Van Der Beken P.A.
66 Hanover Street, Suite 301
Manchester, NH 03101
603 627-3700
dvanderbeken@slvlaw.com

Cap Inspection Log Sheet (to be completed at least semi-annually)

Inspection Date: _____ **Inspection By:** _____

Use this inspection form to document inspections. If unacceptable conditions are observed, complete form again immediately after repairs are completed.

A. Asphalt and Concrete Paved Surfaces - observe surfaces for cracking, holes, material removed during construction, and/or other damage. Also inspect joints separating different cap materials.

All surfaces acceptable? _____ **YES** _____ **NO**

If no, describe unacceptable conditions:

Location _____

Condition _____

Describe any repairs conducted since previous inspection: _____

All repairs adequate? YES NO

B. Concrete Building Floor Surfaces - observe concrete for cracking, holes, concrete removed during construction, and/or other damage. Also inspect joints separating different cap materials.

All concrete building floor surfaces acceptable? _____ **YES** _____ **NO**

If no, describe unacceptable concrete:

Location _____

Condition _____

Describe any repairs conducted since previous inspection: _____

All repairs adequate? _____ YES _____ NO

C. Landscaping - observe landscaping for erosion, animal holes, excavation, vegetation health.

All landscaped areas acceptable? _____ **YES** _____ **NO**

If no, describe unacceptable conditions:

Location _____

OTHER COMMENTS: _____

Upon completion of cap inspection, please mail a copy of the completed form to each of the following locations

:Lawrenceville, LLC	CDW Consultants, Inc.	Stebbins Lazos & Van Der Beken P.A.
1359 Hooksett Rd.	40 Speen Street, Suite 301	66 Hanover Street, Suite 301
Hooksett, NH 03106	Framingham, MA 01701	Manchester, NH 03101



*Risk -Based Cleanup & Disposal Plan
145-155 Beech Street, Chelsea MA
MassDEP RTN 3-17917*

APPENDIX L

Certification of File Location



Richard Pantano
Chairperson

City of Chelsea
Economic Development Board
City Hall, Room 101, 500 Broadway
Chelsea, Massachusetts 02150

Tel: (617) 466-4180

Fax: (617) 466-4195

John DePriest, AICP
Staff

145-155 Beech Street, Chelsea, MA

April 2015

CERTIFICATION OF FILE LOCATION

Pursuant to 40 CFR 761.61 (a)(3)(i)(E), all sampling plans, sample collection procedures, sample preparation procedures, extraction procedures, and instrument/ chemical analysis procedures used to assess or characterize the PCB contamination related to the investigation and cleanup activities specified herein will be maintained in the following location and will be accessible for inspection by the United States Environmental Protection Agency:

Office of Stebbins Lazos & Van Der Beken P.A.
66 Hanover Street, Suite 301
Manchester, NH 03101



Property Owner's Representative Signature

4/14/15

Date

Richard Pantano – Chair, Economic Development Board

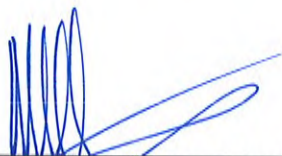
Property Owner's Representative Printed Name

Address of Property Owner:
The City of Chelsea
Economic Development Board
Chelsea City Hall
500 Broadway
Chelsea, MA 02150

CERTIFICATION OF FILE LOCATION

Pursuant to 40 CFR 761.61 (a)(3)(i)(E), all sampling plans, sample collection procedures, sample preparation procedures, extraction procedures, and instrument/chemical analysis procedures used to assess or characterize the PCB contamination related to the investigation and cleanup activities specified herein will be maintained in the following location and will be accessible for inspection by the United States Environmental Protection Agency:

Office of Stebbins Lazos & Van Der Beken P.A.
66 Hanover Street, Suite 301
Manchester, NH 03101



Cleanup Party's Representative Signature

4/15/15
Date

Mark R. Stebbins – Managing Member
Cleanup Party's Representative Printed Name

Address of Cleanup Party:
Lawrenceville, LLC
1359 Hooksett Rd.
Hooksett, NH 03106